

computing today

SEPTEMBER 1982

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FOR A PERSONAL
APPROACH TO MICROCOMPUTING

THINKING ABOUT A PORTABLE MICRO? We review Grundy's NewBrain

Special Report on
an educational micro

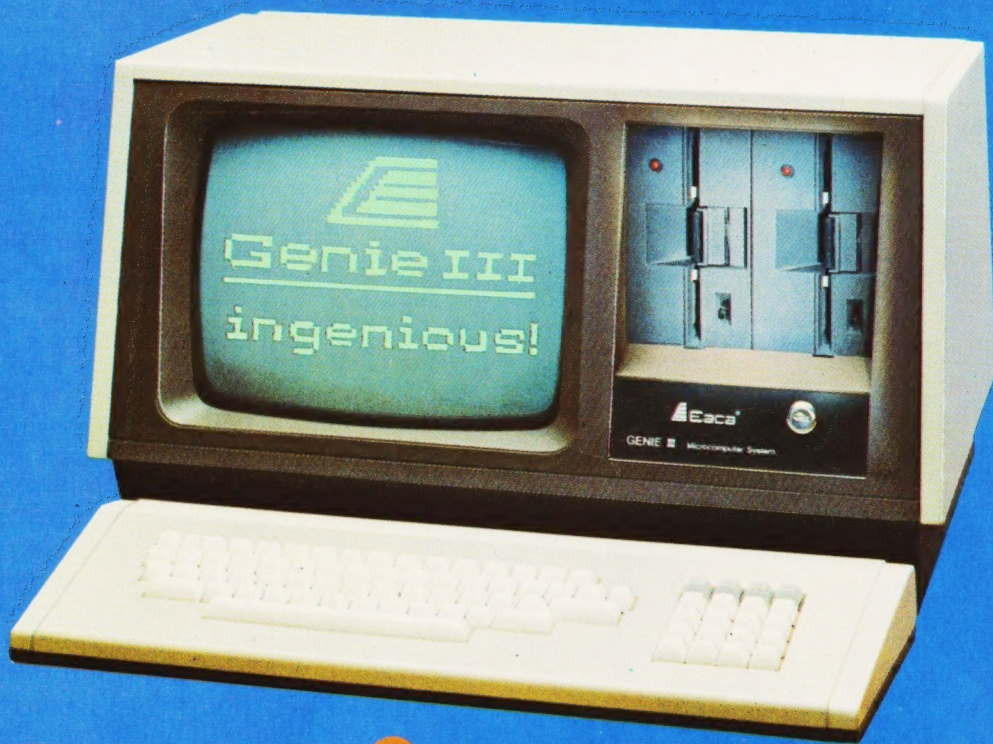
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beginner's guide to
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All material should be typed. Any programs submitted must be listed (cassette tapes and discs will not be accepted) and should be accompanied by sufficient documentation to enable their implementation. Please enclose an SAE if you want your manuscript returned, all submissions will be acknowledged. Any published work will be paid for.

All work for consideration should be sent to the Editor at our Charing Cross Road address.

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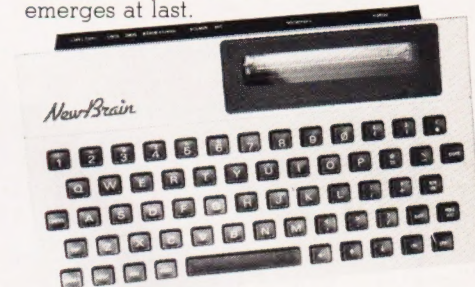
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introducing the

ZX81 KLIK-KEYBOARD

This is a full, forty key, moving keyboard that fits in the recess left after peeling off the existing 'touch sensitive' keypad.

Consider the following advantages

- POSITIVE feedback from keys.
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The fully built keyboard requires **ABSOLUTELY NO SOLDERING**, as the keyboard is supplied with flexible connectors which simply plug into the existing sockets.

Alternatively, the keyboard is available as an easy to build kit at a considerable saving in cost.

Other ZX81 products available include a user port with 16 I/O lines at £16.50 built, keyboard bleeper which fits inside the case at £8.95 built and a repeat key kit at £3.95.

STOP PRESS

New for the ZX Spectrum A 24 Input/Output Port which makes use of the command IN and OUT. The Port is built around a M.O.S. Chip which imposes virtually no D.C. load on the data lines.

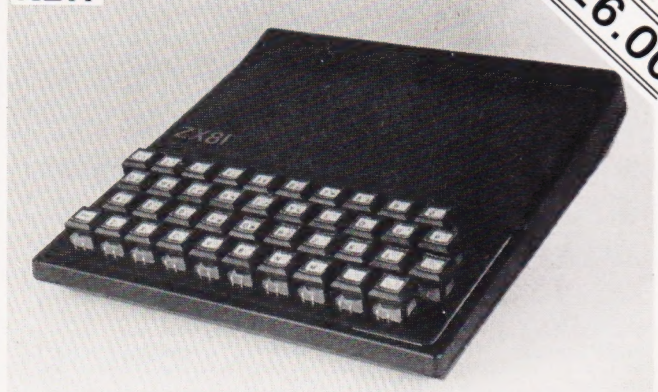
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Proprietor A. Pandaal B.Sc. P.G. cert. Ed.

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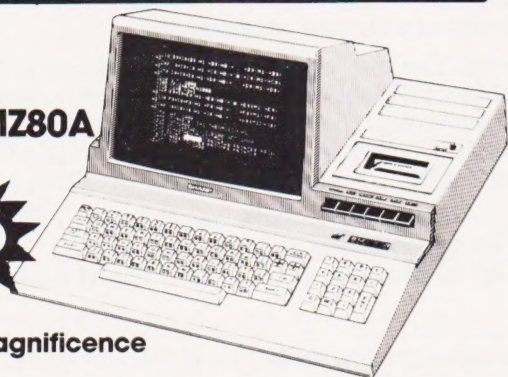
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£475
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Educational — Geography, Maths, Spelling + 4 part BASIC tutorial.

Gemini GALAXY 1 CP/M COMPUTER SYSTEM

A Multiboard based 80-BUS computer

HARDWARE

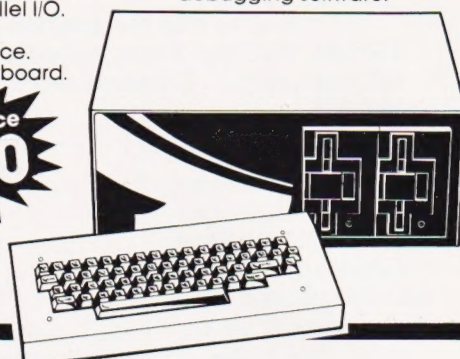
- ★ Twin Z80A CP/M System.
- ★ 64K Dynamic RAM.
- ★ 800K Disk Storage (Formatted).
- ★ 80 x 25 Screen Format.
- ★ Inverse Video.
- ★ Prog Character Generator.
- ★ 160 x 75 Pixel Graphics.
- ★ Centronics Parallel I/O.
- ★ RS232 I/O.
- ★ Light pen interface.
- ★ 59-Key ASCII Keyboard.

SOFTWARE INCLUDED

- ★ Full 64K CP/M 2.2 with screen edit facility.
- ★ COMAL-80 structured BASIC.
- ★ GEM ZAP Assembler/ Editor.
- ★ GEM PEN Text Editor.
- ★ GEM DEBUG debugging software.

MicroValue price
£1,450
+ VAT

Suggested monitor for use with the Galaxy. **£150 + VAT**



Quantum HI-RES FOR MZ80K

High resolution plotting on your MZ80K down to a resolution of a single dot within a character cell.

A new BASIC is supplied with the following additional commands: LINE, WIPE, G SET, G RESET

NEW FROM
Quantum



QUANTUM HI-RES
£110
+ VAT

Quantum HI-COPY FOR MZ80K

This combination of hardware & software not only allows printing of the full Sharp character set, but allows a full High Resolution print of the actual screen if used with the Hi-Res graphics option.

Available in 2 versions

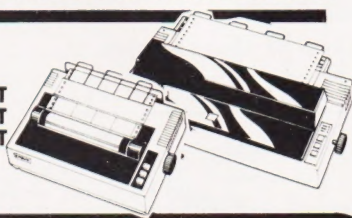
QUANTUM GP100A HI-COPY
SEIKOSHA GP100A, Interface, ROMS & screen dump BASIC.
£300.00 + VAT
including printer

QUANTUM EPSON HI-COPY
Interface & ROMS & screen dump BASIC suitable for use with any EPSON PRINTER.
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EPSON PRINTERS

Epson MX80 Type III **£349 + VAT**
Epson MX80 FT Type III **£389 + VAT**
Epson MX100 Type III .. **£499 + VAT**



QUIBS-Quantum INTEGRATED BUSINESS SYSTEM

A business accounts package developed for the Galaxy, menu driven.

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4. **STOCK CONTROL** costing reports, price lists, etc.,

The system is fully integrated. Comprehensive audit trails are printed. Specially developed for Multiboard based systems.

£400 + VAT
Specify disk format when ordering

Quantum DATAFLOW

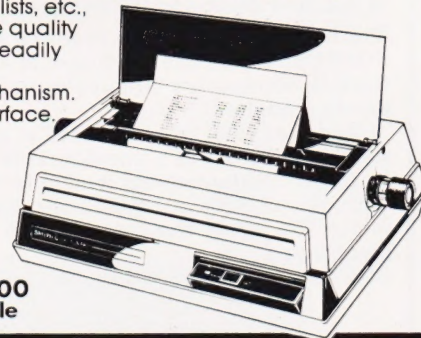
A Data base management and information retrieval package. Allows searching, sorting, report printing, file printing and label printing. Anything which is filed manually can be filed more efficiently with DATAFLOW. For all multiboard CP/M systems.

£120 + VAT
Specify disk format when ordering

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For less than the price of some dot matrix printers, the Smith-Corona TP-1 brings the benefits of daisywheel printers within the reach of most micro users. Now letters, documents, forms, invoices, reports, price lists, etc., can be printed with the quality that until now was not readily affordable.

- ★ Simple reliable mechanism.
- ★ Serial or Parallel interface.
- ★ IEEE option.
- ★ Single sheet and fanfold paper.



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Music Paper available

YOUR LOCAL MicroValue DEALER

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Tel: (0272) 421196

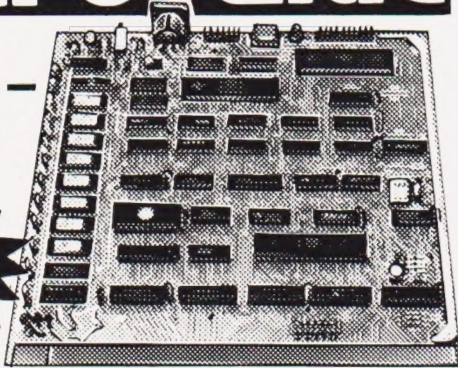
EDINBURGH Computer
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80-BUS PRODUCTS — NEW FROM Gemini

ONLY £225 + VAT



GM813 CPU/64K RAM Card

The Gemini GM813 is a new 80-BUS compatible CPU card incorporating 64K dynamic RAM and utilising the powerful Z80A microprocessor running at 4MHz. Extended addressing and page mode facilities allow for future memory expansion up to 2 megabytes. Input and output capabilities include both programmable serial and parallel interfaces — RS232, 1200 baud CUTS cassette interface and the Z80A PIO. When used with the GM812 video card, the GM813's unique RP/M monitor allows the creation of cassette or EPROM based programs or files which are upwards compatible with a disk based CP/M system.

OTHER 80-BUS PRODUCTS FOR nascom & Gemini SYSTEMS

GM816 GEMINI I/O BOARD

The new GM816 Gemini I/O board takes a unique approach to the problems of interfacing your Nascom or Gemini Multi-board to external devices. This 80 Bus and Nas-Bus compatible card is supplied fully built, populated and tested and includes three Z80 PIOs, a CTC and a Real Time Clock with battery back-up. In addition, a range of 'daughter' boards that attach straight to the I/O board are under development, catering for a wide variety of interfacing requirements.

GM816 Gemini I/O board
MicroValue price —
£125 + VAT

Prototyping daughter board
MicroValue price —
£18 + VAT

EV814 EV COMPUTERS IEEE-488 BOARD

The EV Computers' IEEE-488 card is an 80 Bus and Nas-Bus compatible card designed to fully implement all IEEE-488 interface functions. This built and tested card gives the user a very cost effective and versatile method of controlling any equipment fitted with a standard IEEE-488 or GP1B interface.

MicroValue introductory price
£140 + VAT

MP826 MICRODE 32K BATTERY BACKED STATIC RAM CARD

Provides 32K bytes of battery backed RAM. Page Mode is fully supported offering 1 x 32K or 2 independent 16K pages of memory retained for over 40 days without external power.

MicroValue price £170 + VAT

SOFTWARE FOR THE Gemini MULTIBOARD SYSTEM

- COMAL 80*** — The extended BASIC with powerful PASCAL structures at **£100 + VAT**
- GEM PEN*** — A comprehensive text editor and text formatting package at **£45 + VAT**
- GEM ZAP*** — A very fast Z80 assembler with comprehensive screen editing at **£45 + VAT**
- GEM DEBUG** — A debugging utility program including trace and disassembly features. **£30 + VAT**
- COM-PAS** — An interactive PASCAL system with on-screen editor. Generates Z80 machine code. **£150 + VAT**
- COPY SB** — Allows transfer of programs and files between Gemini DDDS and Superbrain DD & QD formats. **£30 + VAT**
- LIST/REPAIR** — LIST replaces the CP/M TYPE command and provides paging, headings, line numbering, etc. REPAIR is for G809/G815 systems and allows reading and writing of individual disk sectors to assist recovery of lost data. **£25 + VAT**

* Available on cassette or disk

COMING SOON — AP/L

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Choose from either the industry standard CP/M 2.2 D.O.S. or POLYDOS — a unique, versatile and well presented DOS that includes an editor, assembler and adds disk commands to the Nascom BASIC.

CP/M 2.2 — for use with GM805 **£100 + VAT**
POLYDOS 1 — for use with GM805 **£90 + VAT**
CP/M 2.2 — for use with GM815 **£100 + VAT**
POLYDOS 2 — for use with GM815 & GM809 **£90 + VAT**

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NASCOM PRODUCTS & PERIPHERALS

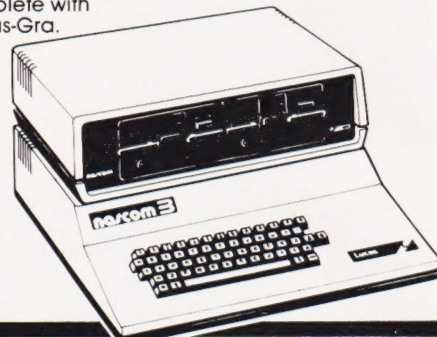
NASCOM 3 AVAILABLE FROM MICROVALUE

Based around the successful Nascom 2 computer, this new system can be built up into a complete disk based system. Supplied, built and tested complete with PSU, Nas-Sys 3 and Nas-Gra.

48K system
MicroValue price —
£499 + VAT

Dual floppy disk unit (0.7 MB storage)
MicroValue price —
£685 + VAT

CP/M 2.2
MicroValue price —
£100 + VAT



MICROVALUE'S 'NASCOM SPECIAL'

MV-N2 SPECIAL — comprises of a Nascom 2 kit, Nas-Sys 3, Nas-Gra Graphics ROM, Bits & PCs programmers aid, Gemini GM807K 3AMP PSU kit, Gemini GM802K 16K RAM kit (expandable to 64K) and a Micro mother board.
Normal RRP over £405
MicroValue price **£340 + VAT**
save £65

NASCOM 2 KIT **£225 + VAT**

Built & Tested **£285 + VAT**

80x25 VIDEO FOR nascom

Nascom owners can now have a professional 80x25 Video display by using the Gemini G812 Intelligent Video Card with onboard Z80A. This card does not occupy system memory space and provides over 50 user controllable functions including prog character set, fully compatible with Gemini G805 and G815/809 Disk Systems. Built and tested.

£140 + VAT

GM180 NASCOM 2 GRAPHICS KIT — gives Nascom 2 graphics capability to your Nascom 1.
only **£20 + VAT**

NASCOM 1 PRINTED CIRCUIT (inc. parts list)
£25 + VAT

SOFTWARE FOR nascom

- POLYTEXT** — a text editor/formatting package for use with POLYDOS. **MicroValue price** **£35 + VAT**
- MATHSPAK** — Double precision maths package on tape. **MicroValue price** **£13 + VAT**
- MATHSPAK HANDLER** — Used in conjunction with MATHSPAK. **MicroValue price** **£9.95 + VAT**
- COMMAND EXTENDER** — For use with MATHSPAK it extends BASIC's reserve word list. **MicroValue price** **£9.95 + VAT**
- LOGIC SOFT RELOCATER** — A software relocating package which allows disassembly and reassembly from anywhere on the memory map. **MicroValue price** **£13 + VAT**
- NASPEN** **RRP** **£30 + VAT** . **MicroValue price** **£20 + VAT**
- Nas-Sys 3** **RRP** **£25 + VAT** . **MicroValue price** **£13 + VAT**
- NasDis D-Bug (EPROM)** **RRP** **£50 + VAT** . **MicroValue price** **£30 + VAT**
- NasDis D-Bug (TAPE)** **RRP** **£40 + VAT** . **MicroValue price** **£20 + VAT**
- Imprint** **RRP** **£30 + VAT** . **MicroValue price** **£20 + VAT**
- Bits & PCs Prog Aid** **RRP** **£28 + VAT** . **MicroValue price** **£20 + VAT**

Gemini DISK SYSTEM FOR nascom

GM809 — full Nas-Bus floppy disk controller card — drives up to 4 drives — optional 8" expansion — **£125 + VAT**.
GM815 — Double density disk system.

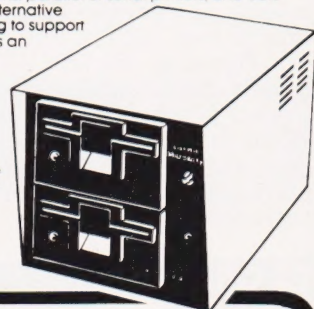
With a thousand in daily use, the Gemini Disk system is now the standard for Nascom and Gemini Multiboard systems. Single or twin drive configurations are available, giving 350K storage per drive. The CP/M 2.2 package available supports on-screen editing with either the normal Nascom or Gemini IVC screens, parallel or serial printers, and auto single-double density selection. An optional alternative to CP/M is available for Nascom owners wishing to support existing software. Called POLYDOS 2, it includes an editor and assembler and extends the Nascom BASIC to include disk commands.

Single drive system (G809, G815/1)
£450 + VAT

CP/M 2.2 package (G513)
£100 + VAT

Double drive system (G809, G815/2)
£675 + VAT

POLYDOS 2
£90 + VAT



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Tel: (061) 431 4866

WETHERBY, W. YORKS
Bits & PC's
4 Westgate.
Tel: (0937) 63774



FOUR HEADS ARE ▲ BETTER...?

A dot matrix printer, the Amber 2400, has been designed to use four print solenoids aligned horizontally. Each oscillates from side to side covering one quarter of the paper. The paper is incremented forward by one dot height during the return oscillation of the print heads. The 2400 printer has a set of sophisticated software routines to handle the unusual print head orientation and to provide flexible data input options.

Incorporating a range of both serial and parallel input capabilities as standard, the Amber 2400 offers upper and lower case ASCII text, continuous graphics, serial baud rate selectable between 75 and 9600 and its own built in PSU.

Priced at £69.95+VAT, full details can be obtained from Amber Control Ltd, Central Way, Walworth Industrial Estate, Andover, Hampshire. Telephone enquiries can be made on 0264-65951.

ZX GRAPHICS

The manufacturers of the ZX Print 'n' Plotter Jotter and Print 'n' Plotter Film have announced another programming aid for all you lucky Sinclair users.

Titled 'ZX Graphics Programming Made Easy', this full colour, A4 size, 24-page guide illustrates the wide range of

graphics programming techniques which may be exploited on the ZX81. Fully illustrated with examples, listings and a wealth of ideas for games and 'serious' programs, the manual is priced at £1.50.

Orders by post should be addressed to Print 'n' Plotter Products, 19 Borough High Street, London SE1 9SE.

You might also be interested to know that Print 'n' Plotter Products are currently marketing rolls of printer paper, identical to Sinclair's, in packs of five for £10.95.

MICROTAN EXTRAS

A complete disc operating system is now available for the Microtan 65 which will expand the Microsoft BASIC allowing it to run virtually as a disc BASIC.

Called Tandos 65, the system includes a disc controller card priced at £99 + VAT; a single

sided, 40 track drive in a cabinet with PSU at £399 + VAT; a disc connection for £15 + VAT and the Tandos 65 DOS for £35 + VAT.

Tangerine have also released an extended version of FIG FORTH, including a full FORTH assembler and editor, called Tan-FORTH. Available on disc for £35 + VAT and cassette for £29.95 + VAT. Both packages include a 96 page instruction manual; the manual can also be supplied separately priced at £5 + VAT.

Further information can be obtained from Tangerine Computer Systems Ltd, The Science Park, Milton Road, Cambridge CB4 4BH. Telephone enquiries can be made on 0223-60422.

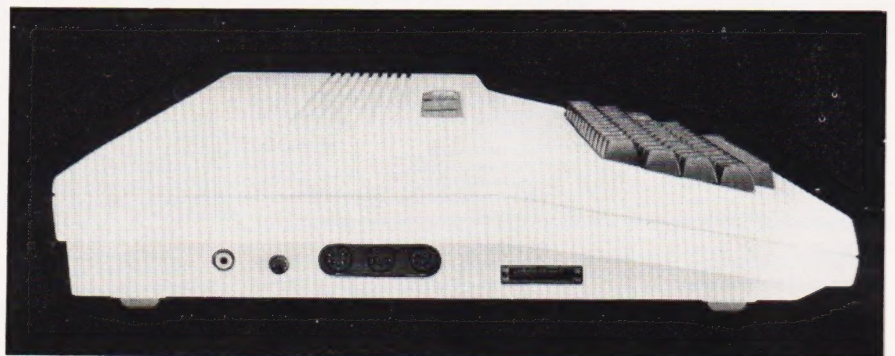
ENTER THE DRAGON ▼

And yet another machine to be launched into the home computing market — the Dragon 32.

Almost entirely British built, this 32K computer is based on the 6809E microprocessor incorporating a professional quality keyboard and Microsoft colour BASIC as standard. Future expansion is to include a second microprocessor, a DOS, other languages and operating systems, and powerful editing features.

The graphics offered by the Dragon 32 include five levels of resolution, nine colours, point by point drawing, lines, arcs, circles, irregular shapes and paint-in operation for solid areas. The machine is also capable of music; it has a five octave range with 255 tones, 155 tempos and 31 volume levels.

Aimed at the family consumer, you can expect to find the Dragon 32 on sale almost everywhere at around £200. For further information get in touch with Dragon Data Ltd, Queensway, Swansea Industrial Estate, Swansea SA5 4EY.



CONSUMER NEWS



COMPUTER CHAT ▲

Do people think you're mad when you talk to your computer? Well, not to worry, here's a machine that will allow your computer to talk back!

Developed for the ZX81, the Speech Pack clips straight onto the rear of the computer; complete with built in speaker and neatly cased to match the ZX81's styling. Don't worry about the usual bits and pieces you normally plug into the ZX81 — these all fit into the back of the Speech Pack.

Supplied with the unit is the Word Pack 1 ROM which includes all the letters of the alphabet, numbers zero to over a million plus other useful words. And if this isn't enough, there are a selection of other Word Packs to extend the vocabulary.

Speech Packs can be obtained from DCP Microdevelopments Ltd, 2 Station Close, Lingwood, Norwich NR13 4AX priced at £49.95. New versions of the Speech Pack will soon be available for other machines in the near future.

IT'S A FACT!

As the Computer Referral Service has now received over 1,000 enquiries, they have decided to produce five factsheets each concentrating on different aspects of computers and computing.

Available free on request, the five factsheets are titled Booklist, Jobs in Computing, Micro-computers in Small Businesses, Computers and Education, and Regional and National Clubs and User Groups. The factsheets will not only supplement the local sources of information and advice already given to enquirers, but are also designed to stand on their own as useful reference documents.

Any or all of these leaflets can be obtained by sending a large

SAE to The Computer Referral Service, PO Box 7, London W3 6XJ. If you have any other problems connected with courses, computer clubs, etc, don't hesitate to write to them as they're very helpful — it'll also save us a fortune in forwarding your enquiries!

PET PORTS

Have you ever wanted to use your Commodore PET to communicate with other devices such as mini or mainframe computers, NC machines, telex equipment or hand-held data capture terminals? You have... well, now's your chance.

Yorkshire Microcomputers have acquired the marketing rights for NETKIT II, the re-designed and upgraded version of the original NETKIT hardware communications interface. And don't think you need a disc drive either, the software is resident in a 4K EPROM on board the NETKIT II itself.

Complete with a detailed operation and application manual, NETKIT II will retail for £150. For further details contact Yorkshire Microcomputers Ltd, 28 Ramshill

Road, Scarborough, North Yorkshire YO11 2QF or 'phone 0723-78136.

THE FLIP FLOPPY

If you don't think you're getting enough storage from your floppy disc, it's probably because you're only using one side!

Now, using the Dennison range of reversible floppy discs, when you fill up one side you simply turn it over and use the other side thus effectively doubling your storage capacity. If you try that little trick with a conventional floppy you'll get in all kinds of trouble!

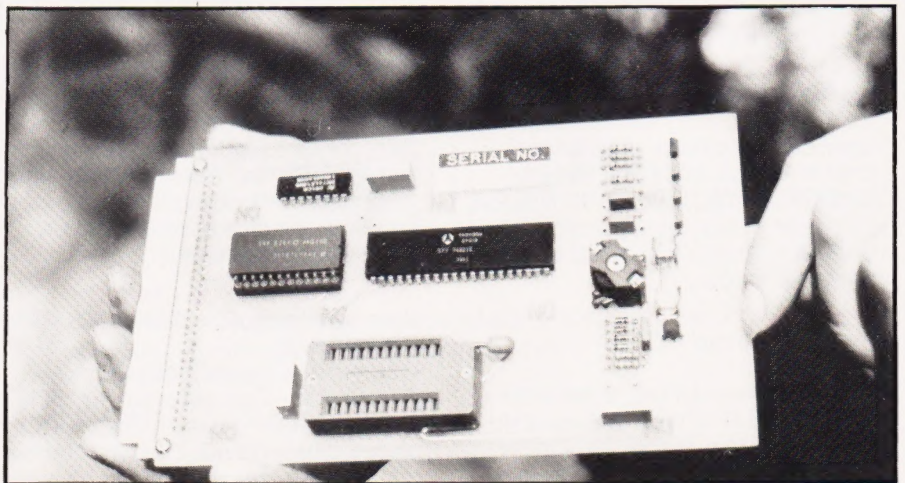
Suitable for use with most single sided disc drive computers including those produced by Apple, Commodore and Atari, the reversible floppies are available for a mere £3.50 each. For further information get in touch with Lion Micro-Computers, Lion House, 227 Tottenham Court Road, London W1 or telephone 01-580 7383.

CUSTOM CARD ▼

A ROM-based, single Eurocard unit, designated 81013a, has been designed to plug directly into PL6 on the back of the Acorn ATOM.

Providing the facility of FREE (blank check), complete or part programming of 2K and 4K EPROMs from ROM or RAM, DUMPing of EPROM or ROM into RAM, and COMPARE, the 81013a also allows comprehensive error checking at keyboard entry. All software is in an onboard ROM.

Completely built, tested and ready to use, the 81013a is priced at £64.95. For further information contact Custom Micro, Russell House, Russell Place, Edinburgh EH5 3HA.



New ZX81 Software from Sinclair.

A whole new range of software for the Sinclair ZX81 Personal Computer is now available – direct from Sinclair. Produced by ICL and Psion, these really excellent cassettes cover games, education, and business/household management.

Some of the more elaborate programs can only be run on a ZX81 augmented by the ZX 16K RAM pack. (The description of each cassette makes it clear what hardware is required.) The RAM pack provides 16-times more memory in one complete module, and simply plugs into the rear of a ZX81. And the price has just been dramatically reduced to only £29.95.

The Sinclair ZX Printer offer full alphanumeric and highly-sophisticated graphics. A special feature is COPY which prints out exactly what is on the whole TV screen without the need for further instructions. So now you can print out your results for a permanent record. The ZX Printer plugs into the rear of your ZX81, and you can connect a RAM pack as well.

Games

Cassette G1: Super Programs 1 (ICL)

Hardware required – ZX81.

Price – £4.95.

Programs – Invasion from Jupiter. Skittles. Magic Square. Doodle. Kim. Liquid Capacity.

Description – Five games programs plus easy conversion between pints/gallons and litres.

Cassette G2: Super Programs 2 (ICL)

Hardware required – ZX81.

Price – £4.95.

Programs – Rings around Saturn. Secret Code. Mindboggling. Silhouette. Memory Test. Metric conversion.

Description – Five games plus easy conversion between inches/feet/yards and centimetres/metres.

Cassette G3: Super Programs 3 (ICL)

Hardware required – ZX81.

Price – £4.95.

Programs – Train Race. Challenge. Secret Message. Mind that Meteor. Character Doodle. Currency Conversion.

Description – Five games plus currency conversion at will – for example, dollars to pounds.

Cassette G4: Super Programs 4 (ICL)

Hardware required – ZX81.

Price – £4.95.

Programs – Down Under. Submarines. Doodling with Graphics. The Invisible Invader. Reaction. Petrol.

Description – Five games plus easy conversion between miles per gallon and European fuel consumption figures.

Cassette G5: Super Programs 5 (ICL)

Hardware required – ZX81 + 16K RAM.

Price – £4.95.

Programs – Martian Knock Out. Graffiti. Find the Mate. Labyrinth. Drop a Brick. Continental.

Description – Five games plus easy conversion between English and continental dress sizes.

Cassette G6: Super Programs 6 (ICL)

Hardware required – ZX81 + 16K RAM.

Price – £4.95.

Programs – Galactic Invasion, Journey into Danger. Create. Nine Hole Golf. Solitaire. Daylight Robbery.

Description – Six games making full use of the ZX81's moving graphics capability.

Cassette G7: Super Programs 7 (ICL)

Hardware required – ZX81.

Price – £4.95.

Programs – Racetrack. Chase. NIM. Tower of Hanoi. Docking the Spaceship. Golf.

Description – Six games including the fascinating Tower of Hanoi problem.

Cassette G8: Super Programs 8 (ICL)

Hardware required – ZX81 + 16K RAM.

Price – £4.95.

Programs – Star Trail (plus blank tape on side 2).

Description – Can you, as Captain Church of the UK spaceship Endeavour, rid the galaxy of the Klingon menace?

Cassette G9: Biorhythms (ICL)

Hardware required – ZX81 + 16K RAM.

Price – £6.95.

Programs – What are Biorhythms? Your Biohythms.

Description – When will you be at your peak (and trough) physically, emotionally, and intellectually?

Cassette G10: Backgammon (Psion)

Hardware required – ZX81 + 16K RAM.

Price – £5.95.

Programs – Backgammon. Dice.

Description – A great program, using fast and efficient machine code, with graphics board, rolling dice, and doubling dice. The dice program can be used for any dice game.

Cassette G11: Chess (Psion)

Hardware required – ZX81 + 16K RAM.

Price – £6.95.

Programs – Chess, Chess Clock.

Description – Fast, efficient machine code, a graphic display of the board and pieces, plus six levels of ability, combine to make this one of the best chess programs available. The Chess Clock program can be used at any time.



Cassette G12: Fantasy Games (Psion)

Hardware required – ZX81 (or ZX80 with 8K BASIC ROM) + 16K RAM.

Price – £4.75.

Programs – Perilous Swamp. Sorcerer's Island.

Description – Perilous Swamp: rescue a beautiful princess from the evil wizard. Sorcerer's Island: you're marooned. To escape, you'll probably need the help of the Grand Sorcerer.

Cassette G13: Space Raiders and Bomber (Psion)

Hardware required – ZX81 + 16K RAM.

Price – £3.95.

Programs – Space Raiders. Bomber. Description – Space Raiders is the ZX81 version of the popular pub game. Bomber: destroy a city before you hit a sky-scraper.

Cassette G14: Flight Simulation (Psion)

Hardware required – ZX81 + 16K RAM.

Price – £5.95.

Program – Flight Simulation (plus blank tape on side 2).

Description – Simulates a highly manoeuvrable light aircraft with full controls, instrumentation, a view through the cockpit window, and navigational aids. Happy landings!

Education

Cassette E1: Fun to Learn series – English Literature 1 (ICL)

Hardware required – ZX81 + 16K RAM.

Price – £6.95.

Programs – Novelists. Authors.

Description – Who wrote 'Robinson Crusoe'? Which novelist do you associate with Father Brown?

Cassette E2: Fun to Learn series – English Literature 2 (ICL)

Hardware required – ZX81 + 16K RAM.

Price – £6.95.

Programs – Poets, Playwrights. Modern Authors.

Description – Who wrote 'Song of the Shirt'? Which playwright also played cricket for England?



Cassette E3: Fun to Learn series - Geography 1 (ICL)

Hardware required - ZX81 + 16K RAM.

Price - £6.95.

Programs - Towns in England and Wales. Countries and Capitals of Europe.

Description - The computer shows you a map and a list of towns. You locate the towns correctly. Or the computer challenges you to name a pinpointed location.

Cassette E4: Fun to Learn series - History 1 (ICL)

Hardware required - ZX81 + 16K RAM.

Price - £6.95.

Programs - Events in British History. British Monarchs.

Description - From 1066 to 1981, find out when important events occurred. Recognise monarchs in an identity parade.

Cassette E5: Fun to Learn series - Mathematics 1 (ICL)

Hardware required - ZX81 + 16K RAM.

Price - £6.95.

Programs - Addition/Subtraction. Multiplication/Division.

Description - Questions and answers on basic mathematics at different levels of difficulty.

Cassette E6: Fun to Learn series - Music 1 (ICL)

Hardware required - ZX81 + 16K RAM.

Price - £6.95.

Programs - Composers. Musicians.

Description - Which instrument does James Galway play? Who composed 'Peter Grimes'?

Cassette E7: Fun to Learn series - Inventions 1 (ICL)

Hardware required - ZX81 + 16K RAM.

Price - £6.95.

Programs - Inventions before 1850. Inventions since 1850.

Description - Who invented television? What was the 'dangerous Lucifer'?

Cassette E8: Fun to Learn series - Spelling 1 (ICL)

Hardware required - ZX81 + 16K RAM.

Price - £6.95.

Programs - Series A1-A15. Series B1-B15.

Description - Listen to the word spoken on your tape recorder, then spell it out on your ZX81. 300 words in total suitable for 6-11 year olds.

Business/household

Cassette B1: The Collector's Pack (ICL)

Hardware required - ZX81 + 16K RAM.

Price - £9.95.

Program - Collector's Pack, plus blank tape or side 2 for program/data storage.

Description - This comprehensive program should allow collectors (of stamps, coins etc.) to hold up to 400 records of up to 6 different items on one cassette. Keep your records up to date and sorted into order.

Cassette B2: The Club Record Controller (ICL)

Hardware required - ZX81 + 16K RAM.

Price - £9.95.

Program - Club Record Controller plus blank tape on side 2 for program/data storage.

Description - Enables clubs to hold records of up to 100 members on one cassette. Allows for names, addresses, 'phone numbers plus five lots of additional information - eg type of membership.

Cassette B3: VU-CALC (Psion)

Hardware required - ZX81 + 16K RAM.

Price - £7.95.

Program - VU-CALC.

Description - Turns your ZX81 into an immensely powerful analysis chart. VU-CALC constructs, generates and calculates large tables for applications such as financial analysis, budget sheets, and projections. Complete with full instructions.

Cassette B4: VU-FILE (Psion)

Hardware required - ZX81 + 16K RAM.

Price - £7.95.

Programs - VU-FILE. Examples.

Description - A general-purpose information storage and retrieval program with emphasis on user-friendliness and visual display. Use it to catalogue your collection, maintain records or club memberships, keep track of your accounts, or as a telephone directory.

How to order

Simply use the FREEPOST order form below and either enclose a cheque or give us your credit card number. Credit card holders can order by phone - simply call Camberley (0276) 66104 or 21282 during office hours. Either way, please allow up to 28 days for delivery, and there's a 14-day money-back option, of course.

**sinclair
ZX81
SOFTWARE**

Sinclair Research Ltd,
Stanhope Road, Camberley, Surrey,
GU15 3PS.
Tel: Camberley (0276) 66104 & 21282.

To: Sinclair Research, FREEPOST, Camberley, Surrey, GU15 3BR.
Please send me the items I have indicated below.

Qty	Cassette	Code	Item price	Total
	G1: Super Programs 1	30	£4.95	
	G2: Super Programs 2	31	£4.95	
	G3: Super Programs 3	32	£4.95	
	G4: Super Programs 4	33	£4.95	
	G5: Super Programs 5	34	£4.95	
	G6: Super Programs 6	35	£4.95	
	G7: Super Programs 7	36	£4.95	
	G8: Super Programs 8	37	£4.95	
	G9: Biorhythms	38	£6.95	
	G10: Backgammon	39	£5.95	
	G11: Chess	40	£6.95	
	G12: Fantasy Games	41	£4.75	
	G13: Space Raiders & Bomber	42	£3.95	
	G14: Flight Simulation	43	£5.95	
	E1: English Literature 1	44	£6.95	

Qty	Cassette	Code	Item price	Total
	E2: English Literature 2	45	£6.95	
	E3: Geography 1	46	£6.95	
	E4: History 1	47	£6.95	
	E5: Mathematics 1	48	£6.95	
	E6: Music 1	49	£6.95	
	E7: Inventions 1	50	£6.95	
	E8: Spelling 1	51	£6.95	
	B1: Collector's Pack	52	£9.95	
	B2: Club Record Controller	53	£9.95	
	B3: VU-CALC	54	£7.95	
	B4: VU-FILE	55	£7.95	
	ZX 16K RAM pack	18	£29.95	
	ZX Printer	27	£59.95	
	Post & packing - only if ordering hardware		£2.95	

TOTAL £ _____

I enclose a cheque/postal order to Sinclair Research Ltd for £ _____

Please charge my *Access/Barclaycard/Trustcard no.

*Please delete as applicable.

Mr/Mrs/Miss _____

Address _____

THREE IN ONE ▶

The Grundy 8200 series of desktop business computers have been designed for use as either stand-alone computers or word processors or as intelligent terminals.

In the basic format, the Grundy 8202 has two 5¼" floppy discs (double sided, double density) with a capacity of 0.5M each. The model 8222 has one floppy drive and one Winchester disc with a capacity of 6M, 12M or 18M. The Grundy series are designed and manufactured in the UK, based around the Z80A microprocessor with a standard 64K RAM which can be expanded to 256K.

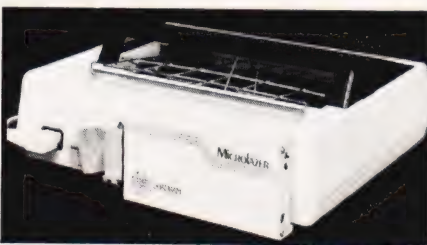
An interesting feature is that the computer is fitted with a security lock to prevent unauthorised access and for OEM applications, the 8200 series can be supplied with a special disc formatting software package exclusive to the particular OEM.

For more details on the Grundy series, priced between £1,850 and £4,900, contact Micro Memory Systems Ltd, Kennet House, London Road, Newbury, Berkshire RG13 1JN. Telephone enquiries can be made on 0635-40405.

THE TOUGHER BUFFER ▼

A universal printer buffer which can be used with most popular micros and parallel printers is now available called the MicroFazer.

Utilising a custom LSI chip, MicroFazer receives data from the computer at up to 4,000 characters per second transferring it to the printer at a rate the printer can cope with — this leaves the computer to get on with more important work while the printing is carried out!



Packaged in a metal case measuring just 3.5" by 7" by 1", MicroFazer allows buffering of 8K, 16K, 32K and 64K dependent on which model you choose. No need to worry though, all machines are



user expandable from 8K to the full 64K using standard 64K 200 nano-second chips.

The 8K, 16K, 32K and 64K models are priced at £145, £160, £185 and £225 respectively. For more information get in touch with Bluedata Ltd, 406a Kenton Road, Harrow, Middlesex HA3 9DW or telephone them on 01-204 9127.

News is that Bluedata may be releasing other models later on this year such as serial to serial, serial to parallel, and parallel to serial.

THE GANG OF FOUR

If you need to store large body of text and information which must be accessed by several operators, the Philips P5005 word processor might be just the machine.

Available with a single flexible disc drive and a Winchester disc drive providing either 9M, 27M or 45M, the system is further backed up by a 10M tape cartridge. Utilising dual Z80 microprocessors, the P5005 is equipped with four workstations of which only one need be local; in addition, an interface is provided for the Philips Satellite remote keyboard.

Obviously, as there are up to four operators, the question of security must rear its cautious head. Not to worry though, there is a function built into the system called the Cluster Administration which allows five levels of user hierarchy: public, designated, restricted, confidential and secure.

Due to its modular design, the P5005 can either be bought as a complete system or created by upgrading the existing P5004 with a further 128K of RAM. For more information, including pricing, get in touch with Philips Business Equipment, Mullard House, Torrington Place, London WC1 or telephone 01-580 6633.

LOOKING TO THE FUTURE

Did you know that the UK market for advanced office equipment is one of the most dynamic growth areas in the business field, and is now worth in excess of £1,500 million.

Well, if you didn't perhaps you ought to get hold of a copy of a new report titled 'Advanced office equipment: UK market prospects in the eighties'. Over the last 12 months, Paul Jenner, business consultant, has examined the size and structure of the UK markets for all types of advanced office equipment products.

With 48 tables and a text of over 20,000 words, this report contains a comprehensive section on the market for computers as well as sections on electronic mail, reprographics and micrographics.

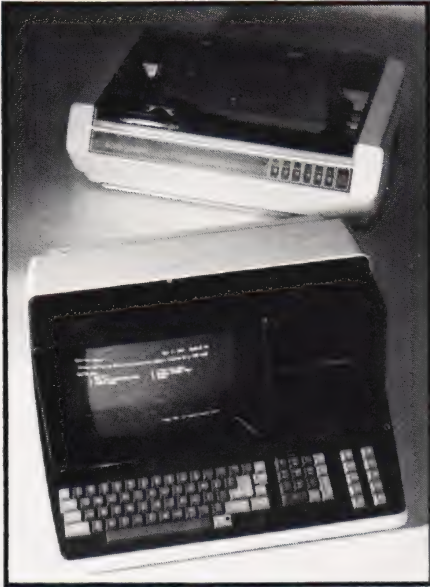
A copy of the report will set you back £185 but if you want subsequent copies, they will only cost £30. For further information contact Euromonitor Publications Ltd, PO Box 26, 18 Doughty Street, London WC1N 2PN or telephone 01-242 0042.

HOW ENTERPRISING...

The Enterprise 100 system, specifically designed to meet the needs of small businesses, is the first in a planned family of integrated desktop micro systems.

Launched earlier this year in the United States, the machine, no larger than a standard typewriter, is based on the microNOVA 16-bit microprocessor with 64K of RAM with a further 4K of mapped memory for the video display refresh area. Two integral 5¼" drives, utilising double sided, double density discs, augment the system providing 716K of on-line storage.

BUSINESS NEWS



Expected to retail around the £5,000 mark, the Enterprise 1000 comes complete with one of three operating systems: BOS/5, supporting a broad range of application packages written in MicroCobol; Enterprise/OS, featuring user friendly menus and security options; and the MP/OS, which supports a variety of high level programming languages, utilities and communication protocols.

Further information is obtainable from Data General Ltd, General Distribution Division, Hounslow House, 724-734 London Road, Hounslow, Middlesex TW3 1PD. Telephone enquiries can be made on 01-572 7455.

GET INTO LINE

The HP 2608S line printer from Hewlett-Packard offers remote printing capabilities, two selectable print densities and simple forms handling.

For remote printing, an optional multipoint interface, used in conjunction with an HP 3000 computer and HP DSN/MTS software, enables multiple users at various sites to use the printer. The printer can also be accessed via hardwire link or modem and can be worked in a daisy chain configuration. An intelligent processor, used for the multipoint option, additionally off-loads the main computer by handling line protocol and provides multiple error checking for each block of data sent to the printer.

The standard HP 2608S can have up to 16 character sets

including an optional large block character set with five letter sizes. Other features include a 'print-one-line' button which makes it easier to align forms, memory back-up that retains forms setting and other data in the event of a power failure, and a paper jam detector.

The list price of the HP 2608S is £7,314. You can find out more about this printer if you write to Hewlett-Packard Ltd, Nine Mile Ride, Easthampstead, Wokingham, Berkshire RG11 3LL or 'phone 03446-3100.

SWEET SIXTEEN ▼

A complete range of multi-user, multi-processor microsystems consisting of small tabletop to large rackmounted systems is now available under the name ACCRON.

The concept of the multi-user, multi-processor system is based on one Service (master) Processor supporting up to 16 User (slave) Processors. Each User Processor consists of a single S100 board with a Z80A, 64K of RAM and an RS232 I/O port running under a dedicated copy of standard CP/M 2.2 but with shared access to large capacity disc drives, up to four (spooled) system printers and/or magnetic tape drives.

A comprehensive nationwide, 24-hour maintenance and repair

service is also available at a fixed annual charge and includes all parts and labour.

The price of the basic ACCRON system is £2,450 but for more detailed pricing information, you should contact Newtons Laboratories, PO Box 789, 111-113 Wandsworth High Street, London SW18 4JB or telephone 01-874 6511.

THE NEW ETONIAN

Microtex of Eton have introduced the Altos Series 5 family of eight-bit microcomputers for business and industry.

There are two models: the 5-15D, which has two built-in 700K formatted double sided 5¼" floppy disc drives; and the 5-5D, which has one 700K floppy disc drive and one 5M Winchester disc drive. Both models are based on the Z80A, feature 192K RAM and can support up to four users simultaneously.

Operating systems for the Series 5 are CP/M 2.2 and MP/M II which provide access to a wide range of application programs. The range also supports the OASIS package.

The price of the basic system is around £2,200. For more details get in contact with Microtex Ltd, 119-120 High Street, Eton, Windsor or 'phone Windsor 55211.



Attention all BBC & ATOM Owners!!

Acorn ATOM MACHINE CODE PROGRAMS

- Dog Fight (12K)** Exciting, two player combat program—in HI RES Graphics Engage the enemy fighters in a battle to the death. £5.95
- Stock-Car (12K)** HI RES. Two Player contest around any of 16 different race tracks. Steering, acceleration and braking controls. Set the level of difficulty for driver and choose the no. of laps. £5.95
- Astro Warrior (12K)** The ASTEROIDS IDEA, but developed and improved!! Flying around the screen you must shoot your way out of difficulty. Aliens attack in increasing numbers. Refuel at specified fuel dumps before you run out. A HI RES game for experts. £5.95
- Super Breakout (3K plus 3Kgr plus Fl. Pt.)** NOT just ANOTHER version!! Equally good in colour and black and white, the program has the advancing walls(s) feature plus genuine curved bat action with 6 ball angles. Terrific sound effects make it a MUST for arcade game addicts. £4.95
- Swarm (12K)** Alien Killer Bees are swarming the Earth. The Queen Bee is indestructible. Your only hope is to destroy the grubs and new born males before they wipe you out. You get three new born males with a bonus at 10000 points. (HI RES graphics). £4.95

ROM SELECTOR BOARD

Suffering from congestion? (PROGRAMMER'S TOOLBOX WORD PROCESSOR etc.) Switch between up to 4 ROMS located at Hex A000. Assembled and tested unit with compact professionally produced PCB and good quality components. Fits easily into the Utility Socket (IC 24). Only £19.50

Adventure

ALL THE EXCITING, INTRIGUE AND FRUSTRATION OF A MAIN-FRAME ADVENTURE! 12K
Explore the tortuous forests, dark caverns and castle dungeons. Beware the maze of twisting tunnels and the desert wastelands. Outwit the predators. Rescue the PRINCESS and carry off the treasures.
Great Skill and imagination are required to play this excellent game and you may still never exhaust all the possibilities.
By devising methods of condensing messages, the author has been able to include many features which would otherwise be available only on much larger computers. Start your adventure now—£7.95



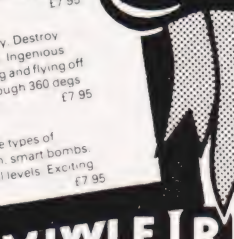
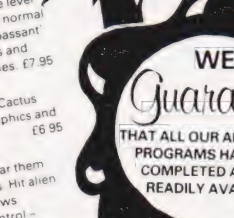
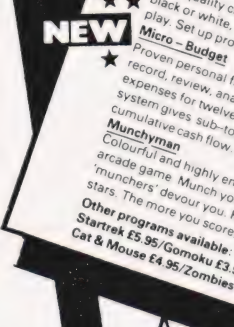
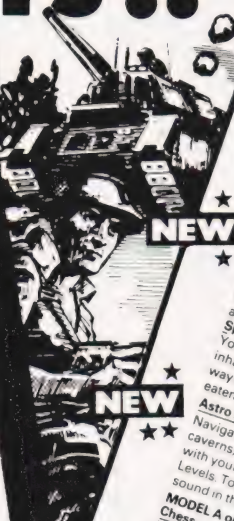
Chess (12K) Improved graphics, plays black or white, mid game level changes, look ahead up to eight moves, offensive, normal and defensive play. Ten sub-levels, castling. 'En passant' by player. Rejects illegal moves. Take back moves and action replay with take over. Set up problem games. £7.95

Cowboy Shoot-Out (12K) Full feature, two player, arcade shooting game. Cactus plants, wagons, animated cowboys. Superb graphics and sound. £6.95

Hyperfire (12K) Aliens have over-run six planets. Object to clear them. Super high-speed action. Four defender ships. Hit alien fuel dumps and alien ships. Aircraft radar shows placement of approaching ships. Thruster control—avoid diagonal movement. Best sound effects yet! Including diagonal movement. £7.95

Air Attack (12K) Command an East Coast anti-aircraft battery. Destroy enemy fighters, bombers and doodle-bugs. Ingenious graphics depict planes approaching, veering and flying off. Search the sky and scan the landscape through 360 degs. GOOD SOUND, GREAT ENTERTAINMENT. £7.95

Space Fighter (6K 3Kgr) Super High Speed 'Defender' game. Five types of intelligent aliens. Repeating laser-cannon, smart bombs, hi-score, rankings, bonus points, six skill levels. Exciting sound effects. £7.95



NEW MODEL B (or 32K MODEL A) Alien Destroyers

- NEW** Sensational, high speed program with an abundance of strong invader fleet of three different types plus Mother ship scoring mystery bonus. Choice of six invader speeds and three bomb speeds. Vertical, angled and exploding missiles. Options to replace defenses and suppress new fleet advance. Bonus bases awarded and Ongoing display of score and hi-score and end of game ranking of top five scores.
- NEW** This program has many unique extras e.g. a 'battle analysis' showing number of each invader shot down, how many Motherships destroyed, number of sheets cleared, shots fired, percentage hits and bases lost. £6.95
- NEW** If you needed a reason to upgrade to 32K, now you have it!
- NEW** **Timetrek** The ultimate 'real-time' Startrek, with Battle Zone indecision your main enemy. Brilliant colour and sound 'One-screen' presentation. Twenty skill levels. Panic Button for 'once-only' space leap. Torpedo sight control. A programming masterpiece!! £7.95
- NEW** **Eldorado Gold** Welcome to a past age, when cowboys ruled the roost and Indians terrorised the new settlers. In ELDERADO COUNTY many fortunes were made—and nearly as many lost! Legend has it that Old Bill McCluskey, who met a rather sudden death, had built up a vast treasure somewhere in the nearby territory. Can you end up a rich man where many have failed? If the marauding Apaches or Big Jake's gang don't get you, you may die of thirst in the desert or starve to death in jail.
- NEW** **World Geography** Beautifully drawn HI RES colour map and graded testing of world capitals and populations, makes learning geographical facts a pleasure. 160 countries covered in total. Pin-pointing of each location in turn aids general awareness. £6.95
- NEW** **Space Maze** You have crash landed in the legendary labyrinth of Titan, inhabited by alien monsters known as 'Frogs'. Find your way out to the 'Transmat' probe before being cornered and eaten. Eight skill levels and 3D colour graphics. £5.95
- NEW** **Astro Navigator** Navigate your way through a variety of treacherous caverns, inhabited by killer rockmites. Avoid the dangers with your climb, dive, reverse and thruster controls. 5 Skill Levels. Top 5 scores ranked. Excellent colour graphics and sound in this exciting 'real-time' game. £5.95
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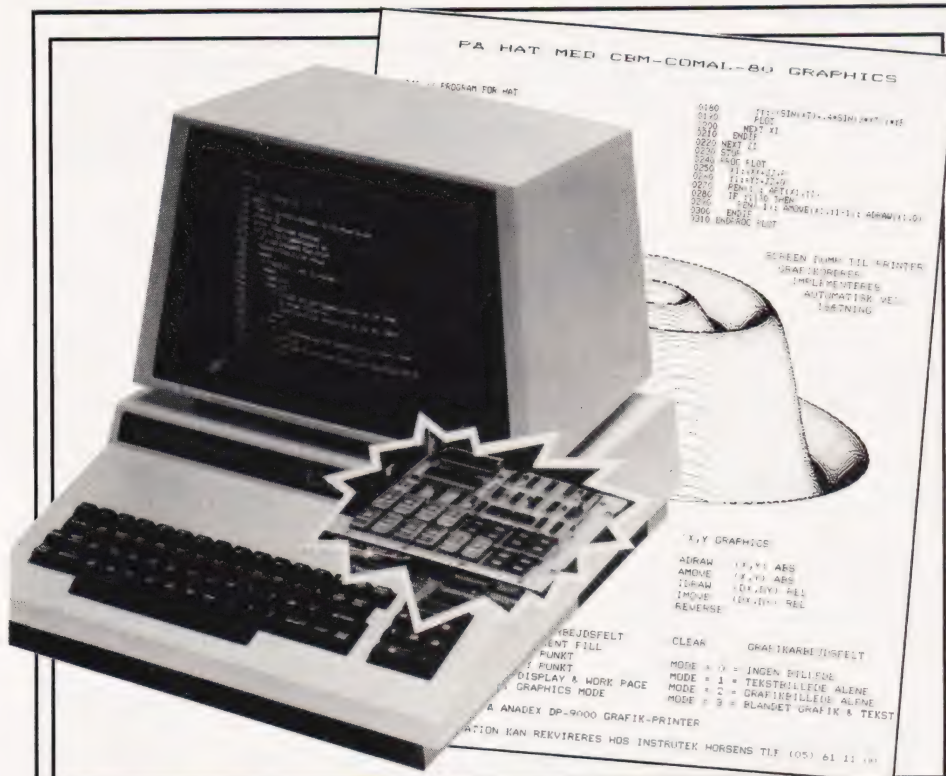
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SOFT WARES



ON BOARD FOR COMAL-80

A 64K PROM board is now available offering Commodore users the capability to produce the complete COMAL-80 kernal and run COMAL without the need for a floppy disc. A semi-compiling ability and full protection of your source code is also provided.

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There is also room for additional devices to be interfaced to the board, which is quite fortunate as there is also an extension board on offer which has been designed to provide high resolution graphics (512 by 256 pixels).

For further details on these boards, including their price, contact Instrutek, Christianscholmsgade, DK-8700 Horsens, Denmark or phone 05-61 11 00 but please don't forget to use the code for Denmark (010 45 5)!

THE WORD'S OUT

Just a few weeks after the launch of the 16-bit Corvus Concept comes a text editing and word processing package capable of converting it into a dedicated word processor.

Called Edword, the package has been specifically designed to

take advantage of the full power of the 68000 processor and the full page concept screen. Edword also offers, in addition to most standard word processor features, wrap-around, hyphenation, automatic margins, page numbering and centering, insert and delete, and cut and paste.

Perhaps the *piece de resistance* of the package is the Time Travel Editing feature allowing the user to undo not only the previous editing action, but all the preceding ones as well, right back to the original.

Edword is provided free of charge when you buy a Corvus Concept — which is priced at £4,250. Further information can be obtained from Keen Computers Ltd, 5 Giltspur Street, London EC1 or by telephoning 01-236 5682.

SMALL IS BEAUTIFUL

Small-LDOS is a disc operating system which has been accepted as standard for the original Video Genie, the Genie I and the Genie 2. It is also compatible with the TRS-80 Model I and a version is available for the TRS-80 Model III.

Complete with system files, library commands, utilities, device drivers, filters and a special version of disc BASIC called LBASIC, the package comes on two discs priced at £38 + VAT.

For further information get in touch with Molimerx Ltd, 1

Buckhurst Road, Town Hall Square, Bexhill-on-Sea, East Sussex, or telephone 0424 - 220391.

WHAT WAS THAT NAME AGAIN?

Ever heard of the Nowotnik puzzle? Neither had I... until a copy of the new games cassette for the 16K ZX81 landed on the review desk.

Named after Dr Nowotnik (!), the game involves juggling differently shaded areas of the screen around to reassemble the original pattern of four large squares. The computer decides how jumbled up the patterns should be but if you're feeling nervous, don't worry, there are five levels of difficulty.

Also included on the tape are two other games: Demolition, a game where you knock down an oncoming wall; and Tenpin, a bowling game.

Priced at £5 + VAT, the cassette is available from Phipps Associates, 99 East Street, Epsom, Surrey, KT17 1EA. Telephone enquiries can be made on Epsom 21215.

MORE ADMINISTRATION!

Stage One Software have launched a suite of computer programs based on their business and administration file management system — the Administrator.

First up is the Administrator II, an extension of the Administrator with many enhancements including facilities for batch input and update; copy over and create files, plus a new and simplified 132-column report generator. A word processor link is also provided.

File Administrator is intended for use in relatively simple mailing and single record-type applications and is suggested for use by very small businesses, societies, clubs and individuals for record-keeping or simple data base purposes.

Lastly, Accounts Administrator will run an accounts system up to the balance sheet stage providing comprehensive management reports.

The Administrator II, File Administrator and Accounts Administrator are priced at £495, £250 and £800 respectively. For further details contact Stage One Computers at 300 Ashley Road, Parkstone, Poole, Dorset or 'phone them on 0202 - 735656.



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KAYDE 16K RAM PACKS

The 16K RAMPACK simply plugs straight into the user port at the rear of your computer. It is fully compatible with all accessories and needs no extra power and therefore it will run quite happily on your Sinclair power supply. It does not over-heat and will not lose memory at all. As you may know some makes go down to 11K after being on for a while.

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CLUB CALL

In response to the demand for up-to-date details on the various Computer Clubs and User Groups, we now publish

It has been very encouraging to see just how many of you are getting together and pooling your resources to form organised clubs and user groups. Indeed, since we published this feature in last month's issue we have been literally flooded with news of clubs all around the country.

If you would like to be included on this page, please drop us a line at:

**Club Call,
Computing Today,
145 Charing Cross Road,
London WC2H 0EE.**

If you present the information in the same format that we print it, so much the better for us. Also, if you want to send in any copies of newsletters and magazines you publish we would be very interested to see them.

MICRO COMPUTER CLUB

81 Stile Croft,
Harlow,
Essex CM18 6LP.
Tel: 0279—20730 (evenings or weekends)
Contact: Bob Robson

Meetings are held on the third Tuesday of each month at the Harlow Advice Centre from 8.00 pm to 10.30 pm.

SHARP MZ80 USERS' CLUB

Yeovil College,
Yeovil,
Somerset BA21 4AE.
Contact: Brian Thomas

The club produces a large magazine full of useful ideas, program listings and projects which is published three times a year. Anyone interested in obtaining further details of the Sharp MZ80 Users' Club or would like a sample copy of their magazine should be sure to enclose a large stamped and self-addressed envelope. Although initially founded for MZ80 users, Brian Thomas would like to confirm that the club now supports users of all the Sharp range of computers, including the recent MZ80A

machine. Annual subscription to the club is £2.00.

THE FAREHAM AND PORTSMOUTH AMATEUR COMPUTER CLUB

22 Sandy Close,
Petersfield,
Hants GU31 4HF.
Tel: 0730—4059 (evenings)
Contact: Peter Smith

Established back in 1980, The Fareham and Portsmouth Amateur Computer Club have recently organised a referral service and a Users Club for the BBC Microcomputer. The group meet at 7.00 pm on the third Monday of each month at the Portchester Community Centre.

TRS-80 EDUCATIONAL USERS GROUP

Beaconsfield First and Middle School,
Beaconsfield Road,
Southall,
Middlesex.
Contact: Dave Fatcher

Formed some 14 months ago, the TRS-80 Educational Users Group has many services to offer its members including a software library containing over 350 programs which relate to the world of Primary, Secondary and Further Education. The group also prepare a newsletter which is published in the national TRS-80 Users Group Newsletter.

HUMBERSIDE SHARP USERS' GROUP AND MICROCOMPUTER SOCIETY

39 Humberville Road,
Immingham,
South Humberside DN40 1AX.
Tel: 0469—75332
Contact: L Bradley

Meetings are held at 7.30 pm on the second Friday of each month in the main Winsford Library in the computer. Courses in computer programming are arranged and membership is currently at £5.00 per annum.

THE COASTAL COMPUTER CLUB

2 Arthur Road,
Hythe,
Kent CT21 6DX.
Contact: D M Leath-Butler
Tel: 0303—60726

The club meets every Monday evening in the Physics laboratory of Wyndgate Upper School, Park Farm Road, Folkestone at 7.00 pm during term time. Meetings offer the opportunity for members to discuss their interests and problems and, on a monthly basis, listen to guest speakers and club members give a prepared lecture on a specialised subject. There is a joining fee of £2.00 and a weekly subscription of 20 pence with a guest fee of 30 pence.

COMPUTER CLUB

19 St Margarets Way,
Blackburn,
Lancashire BB1 1PD.
Tel: 0254—661518
Contact: Dave Walsh

Meetings have been planned for the first Monday of each month and the venue can be obtained by ringing Dave Walsh. The club also publish their own monthly Journal and contributions are welcome from anyone (member or not).

68' MICRO USER GROUP

41 Pebworth Road,
Harrow,
Middlesex HA1 3UD.
Contact: Jim Anderson

The 68' Micro User Group is a newly formed club whose main interest lies in the software and hardware for the 68 set of CPUs. The group also hope to publish a newsletter reflecting the member's views of the various software and hardware available as well as providing information of the meetings and linking members with specialised interests. An SAE would be appreciated for all enquiries as to their next meetings.



DIY SPREADSHEET

The rise to fame of packages such as VisiCalc and Micromodeller has put the name 'spreadsheet' to the forefront of the software market. Many pundits reckon that programs of this type will become as commonplace as word processing packages over the next year or so... a sure pointer to their popularity.

Well, in next month's issue we'll be presenting a complete spreadsheet program that performs virtually all of the usual functions, although on a slightly smaller grid, and yet still occupies less than 2K of memory! How is it done? That would be telling at this stage but suffice to say that the techniques shown can be adapted to almost any micro provided two simple conditions are met.

So, if you fancy learning an awful lot more about the way your micro works *and* getting an excellent program into the bargain, make sure of your copy of the next issue.

SUBROUTINE LIBRARY

One of the commonest methods of writing programs quickly is to start off by loading a library of subroutines into your computer and then add the control structure to them.

The problem comes when you don't have that subroutine library to start with! As a starter for ten (your bonus for 15?) we'll be providing a small suite of simple yet often used routines in the next issue. So, now we've got you going there's no reason to stop there... write your own, send them in and we'll publish the best.

SYSTEM SIMULATION

A story of simple folk perhaps? Well, it could have been but for the fact that a company decided to go computerised. As a first step they wisely bought a microcomputer system to try out some ideas and, as is often the case, found that the system had paid for itself in a few months.

What were they using it for? The original idea was to simulate the characteristics of the mainframe they had chosen or, to be more specific, the terminals connected to the mainframe. The results? Some very interesting findings on how to control the Tandy's cursor and use it for selecting items from program menus, etc.

SHARP PRACTICE

Of all the Japanese micro companies making or promising micros for the UK market, Sharp are the only company to have achieved household recognition. First off their production lines was the MZ-80K, closely followed by the small business oriented MZ-80B. Now, after a couple of hand held computer systems, they are back with a complete low-cost system for the personal computerist. Called the MZ-80A, it looks similar to their previous product but certainly appears to be more usable.

Just what is different about it? Next month our reviewer emerges from the testing ground and reports in on the facts and features.

Articles described here are in an advanced state of preparation but circumstances may dictate changes to the final contents.

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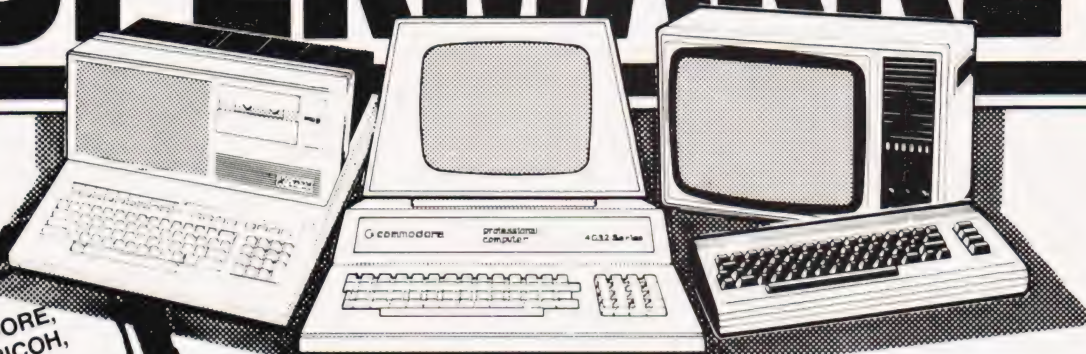
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VIC Joystick		6.52	7.50
VIC Paddle (Pair)		11.00	12.65
VIC Introduction to BASIC 1		13.00	14.95
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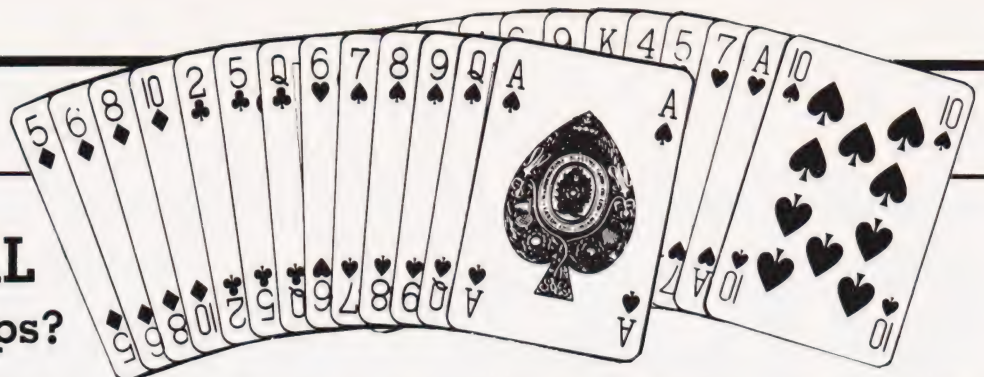
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John Pain

A FAIR DEAL

Bridging the gaps?

When I first played competitive bridge — about 10 years ago — I was rather more interested in how the mechanics of the game worked than on learning how to play the game. My partners will probably say this is still so. However, in recent months I have turned my thoughts to how this very popular game could benefit from the similarly popular pastime of home computing.

Some aspects of this highly entertaining and (unfortunately?) time consuming game quite easily survive the transfer to machine — but to produce a program to bid a complete auction and then play the hand, even with the competence of a palooka, is more than a little difficult. I have therefore decided to ignore this aspect of the game and instead concentrate on the easier option of producing the raw material

for the auction — that is, randomly dealt hands.

The Deal

In most major bridge tournaments in this country, computer dealt hands are used. This allows for the same set of 24 hands to be played by all the competitors (who sometimes number well in excess of 400). The only drawback seems to be that the game's elder statesmen (and stateswomen) — that is those who are politely known as 'Little Old Ladies' — can't stand computer-dealt hands because they produce 'such weird hands'. This is sometimes true — as any true randomly dealt set of cards should do.

In theory, if sufficient people try out this program for long enough, somebody might just get a perfect deal — that is all 13 Spades with North, 13 Hearts with East, 13 Diamonds with South and 13 Clubs with West. However, the odds are 2235197406895366368301559999 to 1 and even dealing 180 hands an hour, it would require in excess of 2×10^{12} years to happen statistically.

The program is written in hands (known in the game as boards) and this information can be printed out in two different ways.

1) In a diamond formation — as seen in the colour supplements. This makes for easier reading but is rather wasteful on paper. However, it details the board number, the vulnerability and the dealer.

2) In a horizontal formation. More difficult to study as a whole, but this is the form in which competition hands are produced. They are usually produced on rather expensive perforated card for distribution to the players. The cards have the board number and compass direction on each hand.

The program is written in BASIC and was developed on a Research Machines 380Z with a single disc drive (double sided). The program takes up 4K of RAM so is easily convertible to other systems. There are no PEEK or POKE statements to convert or indeed any machine code routines — some commands use the particular RML instructions, but these are easily convertible as well.

	Variables Used
B	Number of boards to be dealt.
I/J/K/L/I9	Local Loop variables.
N	Current board being dealt.
Q8	Set either to 68 (for Horizontal) or 72 (for Diamond) printout.
N1	Current Dealer.
N2	Current Vulnerability. (The state of either having scored a 'game' previously or not.)

Lines 10-130	Sets up arrays that will be used - suits, cards, dealer and vulnerability.
Lines 140-200	Asks the operator how many boards are to be dealt and also whether they are to be in Diamond or Horizontal formation. PRINT CHR\$(31) is a control character to have screen print coming down from the top of the screen instead of RML's usual way of scrolling up from the bottom. PRINTER 3 is an RML BASIC command for switching on the printer. The GET routine (Lines 180-200) can be replaced by INPUTs if your BASIC cannot cope.
Lines 210-350	Set the count matrix S(4,4) to 0 and deal the 'cards'. It randomly chooses 39 out of 52 numbers and sets them into 3 hands. The remaining 13 numbers are assigned to hand 4.
Lines 360-430	Each hand is sorted into numerical order and the cards assigned to numbers: 1 = Ace of Spades, 2 = King of Spades and so on down to 52 = 2 of Clubs.
Lines 440-500	The suits in each hand are scanned and the number of cards in each suit assigned to the count matrix.
Lines 510-520	Check the type of output required.
Lines 530-860	Output arranged into Diamond formation. If any suit is void (has no cards in it & therefore 0 in the count matrix), the word 'NONE' is printed; otherwise all suits are printed out.
Lines 870-980	The output is organized into Horizontal formation, again printing 'NONE' for void suits.
Line 990	Completes the loop and gets the next hand.
Line 1000	Finishes the program. PRINTER0 switches the printer off.

Program Listing

```

40 REM ** ARRAYS AND DATA
50 CLEAR 500:DIM CS(13),DS(4),DRS(4),PS(52),VS(16),
  K(52),X(52),Y(52),S(4,4),SS(4)
60 FOR J=1 TO 4:READ SS(J):NEXT J:DATA S,H,D,C
70 FOR J=1 TO 13:READ CS(J):NEXT J:DATA A,K,Q,J,10,
  9,8,7,6,5,4,3,2
80 FOR J=1 TO 4:FOR I=1 TO 13:PS(I+13*(J-1))=SS(J)+
  CS(I):NEXT I:NEXT J
90 FOR I=1 TO 4:READ DRS(I):NEXT I:DATA NORTH,EAST,
  SOUTH,WEST
100 FOR I=1 TO 4:READ DS(I):NEXT I:DATA NORTH,WEST,
  EAST,SOUTH
110 FOR I=1 TO 16:READ VS(I):NEXT I
120 DATA LOVE ALL,NS VUL,EW VUL,GAME ALL,NS VUL,EW VUL,
  GAME ALL,LOVE ALL,EW VUL,GAME ALL,LOVE ALL,NS VUL
130 DATA GAME ALL,LOVE ALL,NS VUL,EW VUL
140 REM ** INITIALISE DATA
150 PRINT CHR$(31)TAB(8)"BRIDGE HAND DEALING PROGRAM":
  PRINT TAB(8)"=====
160 INPUT "HOW MANY BOARDS":B:PRINTER 3:LPRINT
170 PRINT "PRINT HORIZONTALLY OR AS A DIAMOND (H/D)?":
180 Q8=GET():IF Q8=72 THEN PRINT "HORIZONTALLY":PRINT:
  GOTO 210
190 IF Q8=68 THEN PRINT "DIAMOND":PRINT:GOTO 210
200 GOTO 180
210 FOR N=1 TO B
220 PRINT "DEALING HAND"N"NOW"
230 FOR K=1 TO 5:RANDOMISE:NEXT K
240 FOR K=1 TO 52:K(K)=K:NEXT K:A=1:FOR K=1 TO 4:
  FOR L=1 TO 4:S(K,L)=0:NEXT L:NEXT K
250 REM ** DEAL CARDS
260 FOR I=1 TO 39
270 X(I)=INT(52*RND(1)+1)
280 IF K(X(I))=-1 THEN 270
290 Y(A)=X(I):K(X(I))=-1:A=A+1:NEXT I
300 FOR J=40 TO 52
310 FOR I=1 TO J
320 IF K(I)=-1 THEN 340
330 Y(J)=K(I):K(I)=-1:GOTO 350
340 NEXT I
350 NEXT J
360 REM ** SORT HANDS
370 FOR A=0 TO 39 STEP 13
380 FOR J=A+2 TO A+13:I=J-1:Y=Y(J)
390 IF Y>Y(I) THEN 410
400 Y(I+1)=Y(I):I=I-1:IF I>A THEN 390
410 Y(I+1)=Y
420 NEXT J
430 NEXT A
440 FOR J=0 TO 3:FOR K=13*J+1 TO 13*(J+1)
450 IF LEFTS(PS(Y(K)),1)="S" THEN S(1,J+1)=S(1,J+1)+1:
  GOTO 490
460 IF LEFTS(PS(Y(K)),1)="H" THEN S(2,J+1)=S(2,J+1)+1:
  GOTO 490

```

```

470 IF LEFTS(PS(Y(K)),1)="D" THEN S(3,J+1)=S(3,J+1)+1:
  GOTO 490
480 S(4,J+1)=S(4,J+1)+1
490 NEXT K
500 NEXT J
510 REM ** PRINT HANDS IN CORRECT WAY
520 IF Q8=72 THEN 870
530 LPRINT "BOARD ":N,:N1=N:N2=N
540 IF N1>16 THEN N1=N1-16:GOTO 540
550 LPRINT VS(N1),
560 IF N2>4 THEN N2=N2-4:GOTO 560
570 LPRINT "DEALER ":DR$(N2):LPRINT
580 LPRINT TAB(26)DS(1):LPRINT TAB(26)"====="
590 FOR I=1 TO 4
600 LPRINT TAB(26)SS(I9):"[SPC]";
610 FOR K=1 TO 13
620 IF S(I9,1)=0 THEN LPRINT "NONE":GOTO 660
630 IF LEFTS(PS(Y(K)),1)<>SS(I9) THEN 650
640 LPRINT MIDS(PS(Y(K)),2):"[SPC]";
650 NEXT K
660 LPRINT:NEXT I9
670 LPRINT DS(2):LPRINT TAB(52)DS(3):LPRINT "=====":
  LPRINT TAB(52)"====="
680 FOR I=1 TO 4
690 FOR L=0 TO 1
700 LPRINT TAB(51*L+1)SS(I9):"[SPC]";
710 FOR K=13*L+1 TO 13*L+26
720 IF S(I9,L+2)=0 THEN LPRINT "NONE":GOTO 760
730 IF LEFTS(PS(Y(K)),1)<>SS(I9) THEN 750
740 LPRINT MIDS(PS(Y(K)),2):"[SPC]";
750 NEXT K
760 NEXT L
770 LPRINT:NEXT I9
780 LPRINT TAB(26)DS(4):LPRINT TAB(26)"====="
790 FOR I=1 TO 4
800 LPRINT TAB(26)SS(I9):"[SPC]";
810 FOR K=40 TO 52
820 IF S(I9,4)=0 THEN LPRINT "NONE":GOTO 860
830 IF LEFTS(PS(Y(K)),1)<>SS(I9) THEN 850
840 LPRINT MIDS(PS(Y(K)),2):"[SPC]";
850 NEXT K
860 LPRINT:NEXT I9:GOTO 990
870 IF Q8=68 THEN 990
880 FOR I=0 TO 3:LPRINT TAB(20*I+1)"BOARD":N:NEXT I:
  LPRINT:FOR I=0 TO 3:LPRINT TAB(20*I+1)DRS(I+1):;
  NEXT I:LPRINT:LPRINT
890 FOR I=1 TO 4
900 FOR L=0 TO 3
910 LPRINT TAB(20*L+1)SS(I9):"[SPC]";
920 FOR K=13*L+1 TO 13*L+13
930 IF S(I9,L+1)=0 THEN LPRINT "NONE":GOTO 970
940 IF LEFTS(PS(Y(K)),1)<>SS(I9) THEN 960
950 LPRINT MIDS(PS(Y(K)),2):"[SPC]";
960 NEXT K
970 NEXT L
980 LPRINT:NEXT I9
990 LPRINT:LPRINT:NEXT N
1000 PRINTER 0:PRINT "END OF PROGRAM":CLEAR 100:END

```

Jeremy Ruston

EXIDY EDITOR

The Sorcerer didn't have a screen editor ... until now!

This program gives the Sorcerer an ATOM-type screen editor to compensate for the lack of a built-in editor of any kind. The code is so short it is hardly worth saving it on cassette since it only takes a couple of minutes to enter it by hand using the Sorcerer's machine code monitor.

The program is entered in any convenient area of memory (0000 Hex is convenient), and then the Sorcerer is instructed to get its input from the editor by re-directing the RDCH vector.

After it has been entered, type, while still in the monitor, 'SEI=(address of routine)'. You can then return to BASIC by typing 'PP'.

Using It

In use, the routine makes the computer ignore the cursor control codes allowing you to move the cursor to any point on the screen

without generating a '?SYNTAX ERROR'.

When the cursor is positioned on the screen, pressing the 'reverse slash' will get a new character from under the cursor instead of from the keyboard. In practice, to edit a BASIC line, one would list the line and position the cursor on the first character of the line. You then repeatedly press reverse slash until you get to the characters you wish to alter. Then, either overtype the correct characters or move the cursor up and type the characters to be inserted— then move the cursor back down and copy the rest of the line. To delete certain characters, use the cursor right key instead of copying the characters to be deleted. Remember to finish copying a line right to the end before pressing Return.

In the listing, the byte at 0023

Hex is dependent on memory size. Use '1F' for an 8K machine, '3F' for a 16K machine, '7F' for a 32K machine and 'BF' for a 48K machine.

Program Listing

```

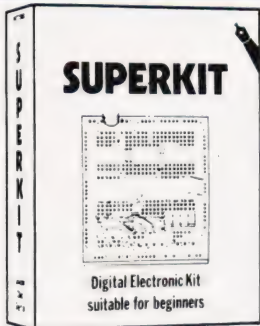
0000 CD 1C EB          CALL EB1C Input
                          routine
0003 FE 13            CP 'Cursor Right'
0005 28 13            JR Z,CURSOR-$
0007 FE 17            CP 'Cursor Up'
0009 28 0F            JR Z,CURSOR-$
000B FE 1A            CP 'Cursor Down'
000D 28 0B            JR Z,CURSOR-$
000F FE 01            CP 'Cursor Left'
0011 28 07            JR Z,CURSOR-$
0013 FE 5C            CP 'Reverse
                          slash'
0015 28 0A            JR Z,COPY-$
0017 FE 00            RETURN CP 00
0019 C9                RET
001A CD F0 E9          CURSOR CALL E9F0 Output
                          routine
001D 3E 00            LD A,0
001F 18 F6            JR RETURN-$
0021 3A F8 3F          COPY LD A,(3FF8)
0024 18 F1            JR RETURN-$

```


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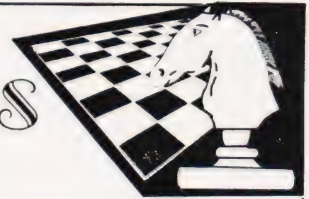
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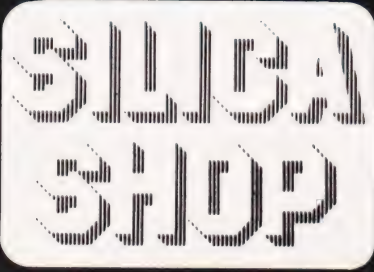
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SPECIAL REPORT

Henry Budgett

An educational micro that's British made? Yes, and it has some very special features for the control enthusiast too.



We hear so much these days about the use of computers in the world of education that we simply tend to accept it as meaning that computers, *per se*, are used for the task of educating. Whilst, on the most general of levels, this is undoubtedly true, the reality is, as always, much more complex.

I tend to view the application of computers in education as being a subject that operates on three levels. The first, and most traditional, is the teaching of the subject of Computer Science. This involves the learning about digital logic, programming and the theory of computer systems. In many cases the topic of the microcomputer occupies just a small fraction of the course material, not because it is unimportant but because the subject is much broader than just that one specific type of computer.

The second level is the use of computers as an aid to learning, whether replacing or augmenting the traditional methods. This is the area gaining much current publicity and the one where most of the effort and money is being concentrated. The third level is probably the least 'interesting' yet, paradoxically, may

well be the one we need most. It is the area of application, the subject of using microprocessors or small microcomputers to control mechanical and electrical systems. It is into this area of the market that the product I'm looking at this month has been unashamedly aimed. Called the Midwich Microcontroller, it is an all British product developed to provide a small desktop micro capable of running other equipment through a variety of interface cards.

An Historical Note

About three years ago an Italian IC manufacturer designed and began to sell a single board micro system that could be expanded to a full system with a VDU, discs, etc. Called the Nanocomputer, it was manufactured by SGS Ates and one of the distributors in the UK was Midwich. The Nano was somewhat expensive and suffered from a number of minor problems which prevented its use in the market for which it had been originally designed. Quite how much this prompted Midwich to proceed with their own system I'm not sure, but the influence is plainly there.

Construction

The case of the Microcontroller made out of structured foam sitting on a steel chassis. It is certainly rigid but its impact strength (ie dropping things onto its top), may be suspect. The top of the case is both wide and deep enough to allow a portable TV or monitor to sit on it, or you could site the experimental unit there. One nice touch is that the ventilation slots are covered internally with mesh thus preventing the ingress of paper clips and the like.

The steel chassis extends up to form the rear panel of the unit and is securely attached to the lid. Indeed, there are so many fixing screws that only the most determined 'peeker' will have the patience to remove them and gain access to the inside!

Once into the interior the overall impression is of neatness. Everything is well laid out, all the components are of top grade and the whole unit has the appearance of being built to last. One tiny little point I didn't like was the use of an IC plug/socket connector for the keyboard. This is attached to the short lead which, all too easily, pulls free when you lift the lid. Now, obviously it's better to have the con-

connector detach itself rather than strain the cable but, if you don't realise what's happening the pins of the plug get very bent. Either a longer lead or a different connector which doesn't deform so easily would be a great improvement here. (I understand that a longer lead is now going to be fitted.)

The experimenter board is a single, naked PCB which is intended to sit on top of, or beside, the main unit. Once again the construction is excellent; a heavier than usual grade of PCB seems to have been used and it is amply supported by rubber feet. Connection to the Microcontroller is made by a 40-way ribbon cable with ID headers at each end. All the logic on the board is again well laid out and the expansion sockets are thoughtfully keyed to prevent the possibility of plugging a board in the wrong way round. The experimental area is made up of a high quality solderless breadboard and there is also provision for a 4K EPROM for your own machine code control programs.

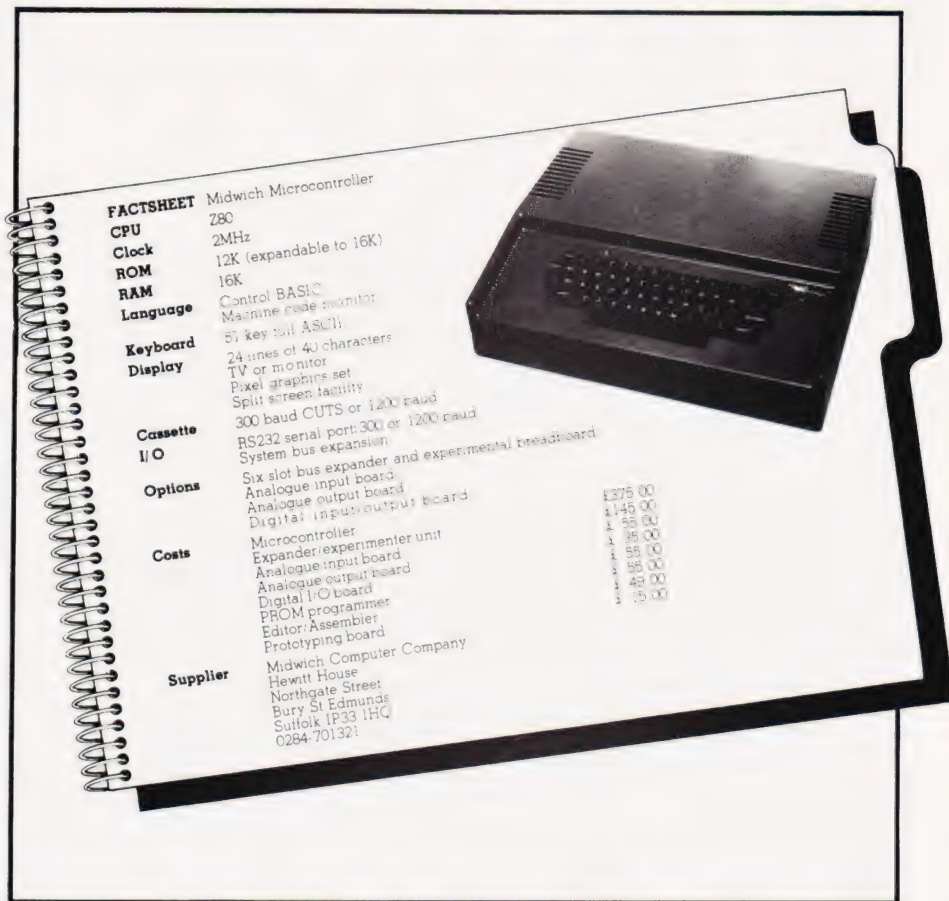
Again, there is only one slight point of worry and that is that the expansion boards have no support — some kind of card frame would be ideal here or even just a set of plastic card guides mounted on a frame would make all the difference. Only a small point but considering the environment the unit will be subjected to, one that may well be worth considering.

Three Card Trick

There are currently three interface cards available to plug into the experimental unit: an analogue input card, an analogue output card and a digital input/output card. While these are an essential part of the system it is unfortunately beyond the scope of a short review such as this to go into great detail about them.

They are all constructed to the same high standard as the rest of the system and all seem to perform as expected. The block diagram shown in Fig. 1 shows the sort of functions they can be expected to provide. One careful and well thought out touch is that all the various trimmers and variable resistors have been positioned so that they are accessible even when the boards are installed in their sockets.

I understand that future boards include an EPROM programmer and a prototyping card for further experimentation, doubtless this range will expand as the versatility



of the system becomes more obvious.

Softly, Softly

What, you may well be asking, is special about Control BASIC. Well, in case you missed a recent issue of CT I'd better explain. Fundamentally (I almost said basically), it is a very specialised dialect of BASIC which incorporates a number of unique features which make the control of external devices easier. Many of the usual and familiar BASIC commands and functions are present together with the special functions developed for the language by a joint team comprising the Government's Warren Spring Laboratory and Oxford University's Engineering Science Department.

The language supports real-time operations and is equipped to function under external interrupts and also under the control of its internal clock. This latter function is called scheduling and means that the computer can be running one program whilst waiting for the correct moment to stop that operation and start running another quite separate piece of code. Indeed, without the capacity for this

sort of operation, the system simply couldn't be regarded as a 'controller'.

The movement of information from the computer to the outside and from the outside to the computer is handled by the IN and OUT functions which augment the normal PEEK and POKE commands. The manual claims that the system has a unique double byte POKE and PEEK command called APOKE and APEEK, but obviously no-one there has heard of the NASCOM 2 and so we'll forgive them!

To make life easy for the budding controller - I hope he doesn't grow fat - the MC (that's the user friendly abbreviation for Microcontroller) supports the use of binary, octal and hexadecimal numbers in its BASIC. Simple, effective and why didn't anyone else bother?

Because of the specialised nature of the language in that it is primarily dealing with bit patterns which will be interpreted as control signals rather than as text characters or numerical values, some interesting commands have been provided. Integer variables can be manipulated by selecting a specific bit of the 16 used to store the number. All the usual logical

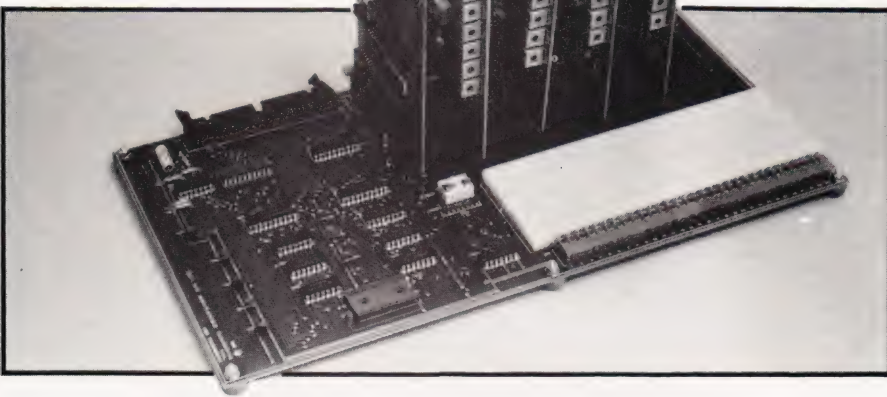
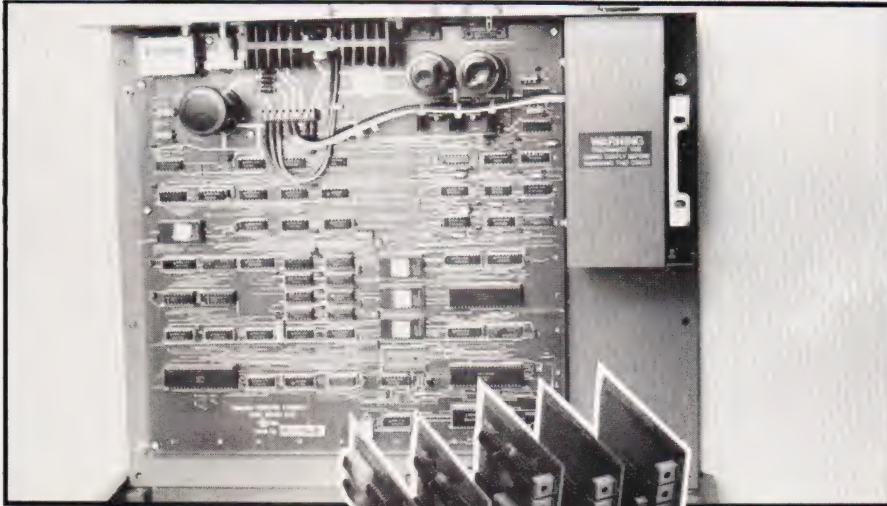
SPECIAL REPORT



Left: The rear panel of the MC. The cassette and serial ports share a single connector.

Below: The insides of the MC showing the neat layout.

Bottom: The experimenter board with some of the interface cards installed.



functions; OR, AND, NOT, etc can be used with integer variables too which is not always the case.

The machine code monitor supports all the usual functions one would expect of such an animal: Modify, Copy, Dump, Save, Load, Breakpoints, etc and can be entered from BASIC at any time simply by typing Control C. You can always tell whether you're in the monitor or BASIC by the prompt character; > for BASIC and # for the Monitor. The manual lists the various routines that may be of use to the programmer together with their operating requirements (which registers get destroyed, etc) and their all important starting addresses. Passing control to a machine code program from BASIC is made surprisingly powerful by the inclusion of the facility to transfer a number of variables to the routine via the stack. Normally, the user can only carry over one or two variables

but on the Microcontroller, the number seems to be almost unlimited.

Manual Interventions

When the unit arrived for review it was pointed out that the manual 'wasn't really for the beginner'. Well, whilst that may be true in the eyes of the manufacturer, and all credit for his concern, it is still a very well put together affair.

Supplied in a ring binder, it puts many other works to shame. The text is divided into four sections: user guide and hardware details, the machine code monitor, Control BASIC and the various circuit diagrams. Often in the past I have criticised computer companies for supplying insufficient information on the inner workings of their systems - here, well there's enough to keep even me quiet for a while. All the hardware is detailed, the various connectors and

operations of the expansion unit covered and even a breakdown of the various useful points to note in the monitor.

Certainly the manual is not for the raw beginner - this is, after all a system designed for use in the classroom with the support of a teacher or lecturer. However, I found nothing really lacking in its explanations and will only pass a couple of minor comments on the volume.

Firstly, I doubt the resilience of a ring binder in the classroom as pages can be torn loose all too easily. Perhaps a spiral bound book would be better but, then again, you wouldn't be able to add your own notes. Secondly, throughout the manual the author insists on using 'programme' and 'Basic'. Not the most important of points but if we are supposed to be using the system to teach it would, in my opinion at least, be nice to use the right words!

Summing Up

Sadly this has only been a quick look at the MC - that doesn't mean that I haven't spent time with it but rather that the report has had to be condensed. As an educational tool for showing students how to control equipment and giving them an insight into the way that microprocessor based systems can be implemented, it can scarcely be faulted. The manuals are good, the construction and design seem excellent and the choice of language has been made for sound reasons and not to satisfy popular 'needs'.

However, as a general purpose machine to be bought for the home (logic forbid that it ever should be), its uses would be somewhat limited unless its owner was into the 'wired home' kick. Still, I'm sure that its designers and makers were well aware of its market and the price level reflects this. I believe that Midwich are considering submitting the system for Government approval as one of the micros for schools and, if they gain this approval, this would mean a substantial reduction in price. After all, you don't really want one of these for each student anyway. (Midwich are currently offering their own, private, educational discount of £30.00 which should prove some incentive.)

Overall, an excellent little system designed specifically for one section of the market and, possibly best of all, it represents British design at its most interesting.

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Occasionally a program comes along of such magnitude that it is hard to describe it, especially within the space allowable in an advertisement. Jumbo is such a program. There have, of course, been flying simulation programs before, but they have all rather fallen into the trap of trying to produce a graphic representation of the ground at some stage or other in the program, thus taking up space, and/or they have concentrated on the single act of flying. In other words, although one gets the feeling of flying a small aircraft, one is not going anywhere.

Jumbo is a fantastically accurate simulation of flying a Boeing 747. These planes are not small, and are not flown by eye. They are flown by eyes and instruments, and the instrument graphics in this simulation are really first class. As you may know, the primary instrument of an aircraft is the artificial horizon. This is simulated very well, and includes instrument landing approach indicators. Graphic maps of very high quality are produced and it is possible to fly in all of the British Isles including Southern Ireland, and to New York on the Eastern U.S. seaboard. The actual airports are at London, Birmingham, Manchester, Prestwick, Edinburgh, Belfast, Shannon and New York.

The program was written by two authors who combined their joint skills to produce a unique piece of software. The programmer got the last byte of performance out of the machine and the pilot the last drop of authenticity out of the simulation. Other simulation programs produce at best a similarity towards flying. With Jumbo you really feel that you are behind the controls.

The authors have used a number of gimmicks and programming techniques. For instance, it is possible to switch on an automatic pilot and to jump forward in time in increments of one minute or one hour — otherwise of course a flight from London to New York or vice versa would take some 8 hours to simulate. Whilst in this time skip the various controls are left as they are but fuel consumption and distance to go are taken forward at their correct rate.

A chart is supplied containing various items of data which you will need, including the take-off data for a 747 with various take-off weights, flap retractions, climb and cruise speeds and descent distances.

Realising that not everybody can fly a 747 and that there is even a large proportion of the population that cannot fly anything, two important items of assistance have been added. First of all is the documentation. This is split into two parts. The second is a "manual" on flying the 747. In other words, the instructions for running the program. The first part, however, is what amounts to an instruction manual for flying. It assumes that the user knows nothing about aircraft and although we do not purport that it gets anybody up to any sort of standard after it has been assimilated, the reader should have sufficient knowledge of flying and the theory of flight to fly in the program itself. The second feature of assistance to the novice pilot is a feature in the program which enables the user to practice landings. When the program is started, if one presses the P key, the aircraft is automatically put 11 miles out from London Airport approaching on an instrument landing.

The controls are pretty well complete, even to dive and wheel brakes. The flying track may be continuously monitored on the map display. Bearing and distance to your intended point of landing are available all the time. The instruments, incidentally, consist of:

Artificial horizon	Attitude	Fuel
Aileron indicators	Compass	Elapsed time
Indicated airspeed	Turn indicator	Distance to landing
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Six maps may be chosen, as follows:

Scotland, Northern England, Southern England, Ireland, Eastern U.S.A., The whole of the U.K.

Route information and present position are shown on the map displayed. It is very difficult to think of any factor that the authors have overlooked. Even the quite meaningful thinning of the air with increasing height, which greatly affects the airspeed indicator in real life, is taken into consideration. Rather than having a fixed stalling speed, this continuously changes with the flight configuration, the weight, height and power setting, again as it does in real life.

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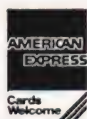
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Upgrade your TRS-80 to full upper and lower case text display.

The Tandy Model 1, Level 2, is normally provided with upper case only, although hardware modification is possible at extra cost by Tandy. As we have recently invested in an Epson MX-80 FT2 printer and a word processor package, we decided to investigate the possibilities of lower case modification for ourselves. The result is the extremely economical modification presented here.

The Storage Story

In order to understand the modification, we must first look at the way in which the TRS-80 stores and uses its video information in video RAM and its conversion by the character generator into the image on the video monitor. Like most microcomputers, the TRS-80 uses ASCII coding to represent alphanumeric and punctuation characters by individual bytes within memory. ASCII is essentially a seven bit code, with a total of 128 control and printable characters. The characters represented by codes 96-127 (binary 1100000 to 1111111) are the lower case counterparts to those represented by codes 64-95 (binary 1000000 to 1011111), but these are not directly available on the TRS-80 Model 1. It should be noted, however, that the upper case and lower case characters differ in only a single bit (bit 5). So, why is the lower case set unavailable on the video screen?

In order to store adequate information in the video memory of the computer for the complete ASCII character set, we need at least seven bits per character. However, when you trace out the video memory on the circuit diagram of the TRS-80, you will find that the video memory seems to lack bit 6 completely. Tandy have used six individual 1024 x 1 bit static RAMs (type 2102) and some rather cunning logic to process what seems to be seven-bit data.

If we look at this area of the circuit (Fig. 1), we can see what is going on during the processing of video information. The first thing to notice is that there is no memory corresponding to bit 6! Bit 6 is in fact synthesised by the NOR gate Z30, which is fed from the data outputs from the bit 5 and bit 7 RAMs. The NOR gate will only provide a logic '1' output if both bit

5 and bit 7 are logic '0'. If we look again at the ASCII codes in binary, this is exactly what we need for upper case only. But for lower case we need what is an impossible combination - both bit 5 and bit 6 at logic '1'. This immediately explains why lower case is undisplayable even by 'POKEing' the video RAM directly with lower case codes, although a little 'PEEKing' into the remainder of RAM will soon convince you that upper and lower case codes are both stored there. Try looking at the ASCII value of a character and its counterpart with SHIFT depressed, if you need convincing further.

What is even more interesting to find, however, is that the character generator chip used by Tandy to decode the ASCII information in video memory into the dot patterns on the monitor is fully capable of producing lower case characters! The chip is an SCM 37350P with the full ASCII set and a few more interesting possibilities besides. Why do Tandy not exploit these? We guess that the board was designed when 2102s were rather more expensive than today and was an economy measure - though the fraction of the total cost of the machine must have been low even then. The present lower case modification by Tandy is rather expensive, in view of the ease of the

actual job and component cost - especially as only one component is needed! In fact, Tandy have made the job ridiculously easy by even socketting the required modification area.

Getting It In

So, how do we install an economical lower case? At this point you need a fine-tipped soldering iron, two pieces of insulated wire about 3" long with the ends stripped for around 1/8" and tinned, and, of course, one 2102 RAM chip. The chip is widely available from a number of the mail-order electronics suppliers and also, from Tandy. You need to remove the six screws from the bottom of the case of the TRS-80 and to gently remove the top case half. Remove the two printed circuit boards carefully as the cable between the keyboard and the main PCB is fairly easy to strain, and turn the boards so the main component side is uppermost. Locate the video RAM chips - you will find that one of them is in an IC socket.

While you are in this region, you can check the character generator type - it is the other socketed chip (Z29) nearby. For those of you who like experimenting, if you gently remove this chip, bend up pin 2 and reinsert the chip in the socket, you will find

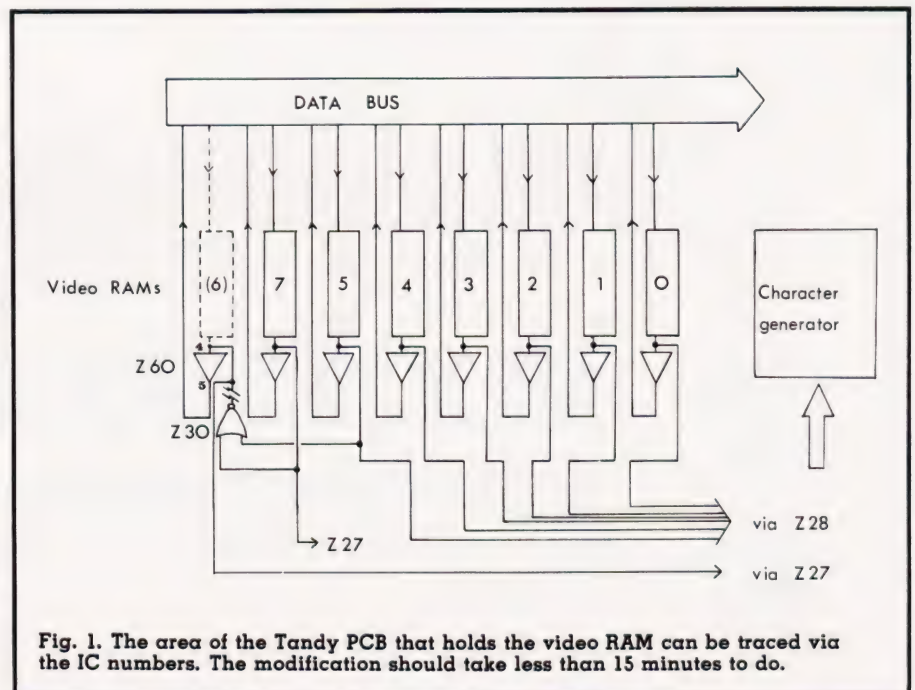


Fig. 1. The area of the Tandy PCB that holds the video RAM can be traced via the IC numbers. The modification should take less than 15 minutes to do.

CASE CONVERTER

that you can change the screen display from upper to lower case and back by switching pin 2 to either 0 volts or 5 volts. However, the whole display will be in one mode - you cannot have both simultaneously.

The actual modification is easy. To provide the correct coding we must store bit 6 rather than synthesise it. Gently extract the socketted video RAM chip - remember they are liable to damage from static electricity - and take your new 2102 chip. Bend pins 11 and 12 out to horizontal and then fit the new chip on top of the original one, taking care they are the same way round. With a minimum of solder and without overheating the chips, solder each of the pins other than 11 and 12 to their counterparts. At this point, you can re-insert the pair of chips into the socket.

What you have done is to parallel all of the address and control lines of these chips. Pin 11 of the new 2102 is its data input and must be wired to data line 6 - the easiest place is pin 5 on the Z60 (tri-state buffer). Pin 12 is the data output and must go to pin 4 of the Z60 - the input of the tri-state buffer for data line 6.

Only one further task remains - to disconnect the output of the original NOR gate from the tri-state buffer. The easiest way is a careful foil cut next to pin 13 of the Z27 (the graphics data latch). Check your connections one last time and that's it!

Jumps In RAM?

After putting the machine back together and powering up, you will probably be disappointed to find yourself in all too familiar upper case. This is because Tandy didn't plan on your hardware modification when they wrote their ROM driver routine for the display. They were kind enough, however, to route all these useful and otherwise immutable routines via RAM vectors (locations in RAM which hold the addresses of the driver routines in ROM). The driver routine for the video display starts at 0458 Hex and this address is held in RAM in bytes 401E (contents 58) and 401F Hex (contents 04). The routine is entered with the character to be printed in the C register and transferred to the accumulator at 0467 Hex. A series of comparisons follow identifying the control and graphics characters, but the area of special interest is at 0477 to 047B Hex where a com-

parison is made to detect lower case and convert it to upper case if found!

The driver routines that follow are written as patches to the ROM routine. The address of the driver routine held in 401E and 401F Hex is changed to the beginning of our modified routines, which then jump back into the normal ROM routine part way through. An assembly listing of the patch is given for those who like to work in machine code, with a BASIC version for the others. You can choose either - those wanting to do this for machine code should decode the DATA statements! Both of these drivers are set up for 16K machines and reside from 32001 up.

If you have more memory or problems with oversized operating languages, you will find they are relocatable but you will obviously need to change the address POKED into 401E and 401F Hex to the new location. Once loaded and run, the BASIC loader is no longer required

and can be overwritten if so desired. With programs such as Newsprint (Prosoft), no driver is needed as one is included.

As a bonus you will find there are a few characters you may not expect! For example, try Shifted @ for the £ sign that you may have always wanted and couldn't find. There are quite a few more as well - have fun finding them.



```

7D01 DD 6E 03          LD L, (IX+03)
7D04 DD 66 04          LD H, (IX+04)
7D07 DA 9A 04          JP C, 049A
7D0A DD 7E 05          LD A, (IX+05)
7D0D B7                OR A
7D0E 28 01            JR Z, 7D11
7D10 77                LD (HL), A
7D11 79                LD A, C
7D12 FE 20            CP 20          ;Jump if
7D14 DA 06 05          JP C, 0506     ;control
7D17 FE 80            CP 80          ;Jump if
7D19 D2 A6 04          JP NC, 04A6    ;graphics/sc
7D1C FE 40            CP 40          ;Jump if numeric
7D1E 38 04            JR C, 7D2A     ;or punctuation
7D20 CB 6F            BIT 5, A      ;invert bit 5
7D22 18 02            JR Z, 7D28     ;to set shift
7D24 CB AF            RESET 5, A    ;default to
7D26 18 02            JR 7D2A       ;lower case
7D28 CB EF            SET 5, A
7D2A C3 7D 04          JP 047D       ;Return to ROM
7D2D 00                NOP
    
```

The Assembly language driver routine for lower case.

```

1  REM ** PROTECT THE ROUTINE BY SETTING MEMORY SIZE
   TO 32000 BEFORE LOADING
5  DATA 221,110,3,221,102,4,218,154,4,221,126,5,183,
   40,1,119,121,254,32,218,6,5,254,128,210,165,4,254,
   64,56,10,203,111,40,4,203,175,24,2,203,239,195,125,
   4,0,0,0,0
10 FOR AD%=32001 TO 32047:READ X:POKE AD%,X:NEXT AD%
15 REM ** LINE 20 SETS VIDEO DRIVER TO 32001
20 POKE 16415,125:POKE 16414,1
25 REM ** TO FORCE UPPER CASE RUN LINE 35 WHICH RESETS
   DRIVER ADDRESS TO 0458 HEX
30 END
35 POKE 16415,4:POKE 16414,80
40 END
45 REM ** TO SET THE SHIFT DEFAULT TO LOWER CASE
   RATHER THAN UPPER CASE RUN LINE 50. TO RESET RUN
   LINE 5
50 POKE 32028,195:POKE 32029,125:POKE 32030,4
    
```

The same program but written in the form of a BASIC loader program. It can be deleted once it has been RUN.

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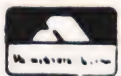
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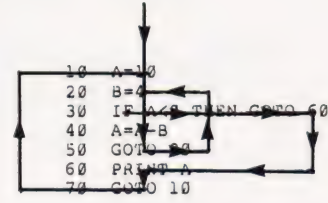


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Having established that there is a difference between programming and coding we look at the steps involved in producing a working system.



Neither of these two example programs does anything useful so don't think you are missing their meanings!

As you might expect, the more tangled and twisted the flow of control line becomes, the more difficult it is to understand the associated program. In BASIC the biggest cause of tangled flow of control is the GOTO statement. If you are used to writing programs 'as you go along' without planning then you will be both haphazard and opportunist in your use of GOTO. In other words you will use GOTO either to get you out of a situation that you have programmed yourself into or you will suddenly see how you can save a few lines by jumping to another part of the program. If you go back and modify such a program then the chances are that you will make the flow of control even more tangled than it was in the first place!

Last month we discovered that writing programs using modules was a good idea in that it provided a systematic way of constructing a program. What we have said nothing about so far is what sort of programming goes on *within* a module. If you are writing a large program then you can use the idea of a module, or subroutine, to break the problem down into a hierarchy of smaller problems — but at some point you still have to write some statements that do something!

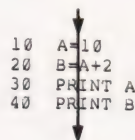
What this comes down to in practice is using IF statements to select between alternatives, FOR loops to repeat things and GOTO to get to other parts of the program. Notice that although it is possible to be precise about what IF and FOR are used for, the statement about the GOTO is very vague — why should we want to 'get to another part of the program'? The answer to this question will emerge in the course of this article but along the way we will meet a collection of ideas that are usually referred to as 'Structured Programming' or SP. So, if you've ever wondered what SP was all about — read on.

An Italian Meal?

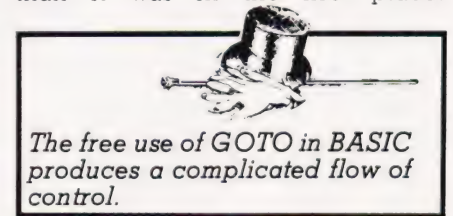
A program is executed one instruction at a time and at any mo-

ment the instruction that is being obeyed may be thought of as 'controlling' what the computer is doing. Thus, as a program runs, control is passed from statement to statement. This often referred to as the 'flow of control'.

In a BASIC program, the rule is that control flows through the program in order of increasing line number unless otherwise directed by a 'control' statement such as IF, FOR, GOTO or GOSUB. If you are given the listing of any BASIC program then you should find it possible to take a pencil and draw lines through a program to trace all the possible paths that the flow of control might take. In a very simple program with no control statements the flow of control line would go from top to bottom. Its 'shape' would therefore be a straight line:



As programs become more complicated and use control statements such as GOTOs, then the flow of control line becomes split and doubles back on itself and its 'shape' becomes complicated:



The result is that most BASIC programs resemble spaghetti. Unfortunately, this spaghetti image has tended to rub off on BASIC rather than on the programmers who produce it.

There is another important problem with spaghetti programs. If you look at any small section of program then, if the flow of control is very mangled, it is almost certain that there will be more than one way of reaching it. Now this may not be a problem if the program is working, but if you're trying to debug it then it can cause unnecessary confusion. The value each variable in the section is supposed to have depends on two things — its initial value and what is done to it in the section.

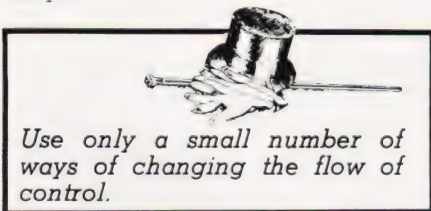
ELEGANT PROGRAMMING

Although what is done to it is fixed and easy to see, if there is more than one way to reach the section of program then it is very difficult to work out its initial values because it depends on which route was taken.

If you agree that spaghetti programs are something that we could well do without then you will be interested to learn that there are some very simple rules that help produce clean, 'well-structured' programs. If you do not see what is wrong with spaghetti then much of what follows will at best seem irrelevant and at worst an unnecessary cramping of your programming style. The usual argument against SP is that 'free style' programming can produce the fastest and most compact programs. This *is* true. However, you *can* produce a program that is just as efficient by writing a well-structured program and then, by changing *only* the parts that are causing it to slow down, you can make it run at an acceptable speed.

Structured Programming

The basic idea behind producing well-structured programs is very simple.



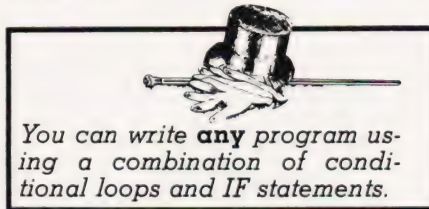
If we choose very simple ways of changing the flow of control and build up larger programs using these then the overall flow of control should be easier to follow for two reasons!

- 1) It should be easier to spot the standard 'shapes' that make up the flow of control line, and
- 2) There should be no 'tangles' in the flow of control line.

If, in addition, each of the ways of changing the flow of control can be put together so that each part of the program can only be reached by one route then so much the better.

At this point you may think that although this solution sounds simple it is impossible to use. Surely you cannot restrict the ways in which control can pass through a program to a few simple forms? After all, think how complicated the flow of control can be in a spaghetti program. Is it really possible to rewrite such a program so that it is well structured?

The answer to both these questions is YES! And this is not just an opinion. It can be proved that you can write *any* program using a very small range of simple changes in the flow of control. In particular, *any* program can be written using only some form of IF statement, that will select between two alternatives, and some form of conditional loop, that will cause a group of statements to be repeated until a condition is satisfied. In terms of the flow of control, the IF statement divides it into two and the loop causes it to go back on itself.



Although you can write programs using only these two types of control it is easier in practice to invent a few more. Traditionally, four types of flow of control have been used to write structured programs:

1) The sequence (see Fig. 1) — This is the default flow of control in all computer languages and corresponds to instructions being executed one after the other.

2) The DO...WHILE (see Fig. 2) — This repeats a sequence as long as a condition, P, remains true. The test is made before the sequence block is entered. Therefore, it is possible to bypass the execution of the sequence at the first test.

3) The DO...UNTIL (see Fig. 3) — This repeats a sequence until a condition becomes true. Notice that in contrast to the DO...WHILE, the test is made after the sequence has been executed — hence the sequence must be carried out at least once.

4) The IF (see Fig. 4) — This tests some condition and carries out sequence 1 if it is true and sequence 2 if it is false.

The choice of these four is sensible in that it includes two types of loop — one that can skip the sequence without ever allowing it to be carried out and one that insists that it is carried out at least once — and an IF that will select between two alter-

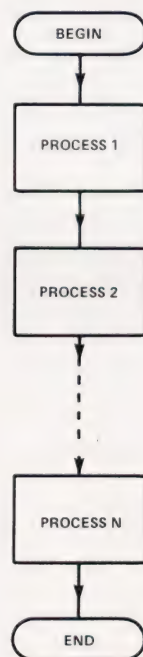


Fig. 1. A straight sequence.

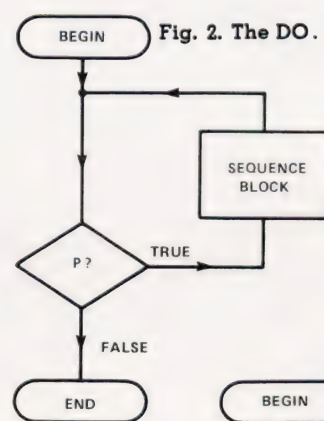


Fig. 2. The DO...WHILE loop structure.

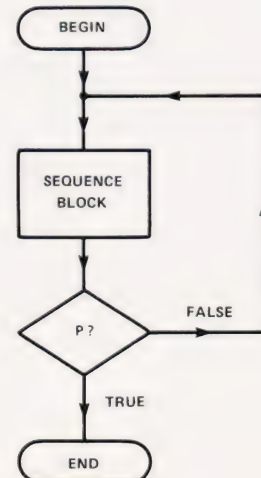


Fig. 3. The DO...UNTIL loop structure.

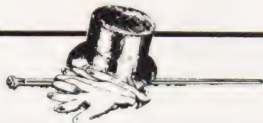
natives. Using these statements you can build any program, no matter how complex.

Many computer languages contain this traditional set as direct instructions. For example, Pascal includes an IF, a WHILE and UNTIL statements. Other languages, for example many versions of BASIC, do not and as a result it is often said that it is impossible to write well-structured programs using them. This, however, is not true. This traditional selection is just that — a **SELECTION**. As long as you include some sort of IF and some sort of conditional loop then you can choose your own set of control statements and use them to write well-structured programs.

In practice there are many advantages in using, or at least knowing about, the traditional set — they are the basis of many computer languages and are used by many other people.

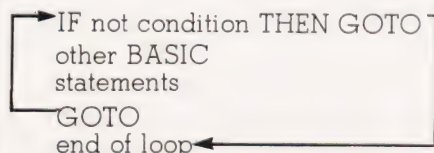
Structuring BASIC

The discussion about structured programming has so far been in general terms and seems to make no reference to any computer language in particular. However, lurking behind this discussion is the shadow of a computer language such as ALGOL or Pascal that includes the traditional structured control statements described above. What this means is that most descriptions of structured control statements described above. What this means is that most descriptions of structured programming concludes with some statement like 'SP is not possible in BASIC'. Indeed, the argument that SP is a good thing is often incorrectly taken to mean that BASIC is a bad thing! But,

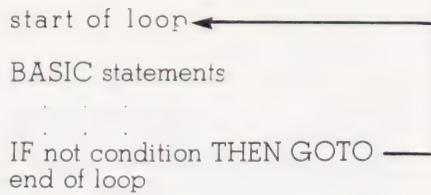


SP is a programming technique applicable in any computer language.

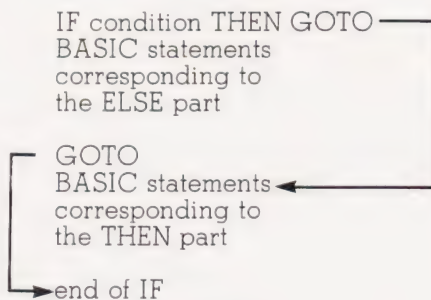
The easiest way of using SP in BASIC is to find equivalents of the traditional set of forms of the flow of control. This is not difficult. For example, a WHILE loop can be written as follows.



The UNTIL loop can be written as:



The standard form of the IF statement is more difficult because of the different ways that the BASIC IF is implemented. Using only the simplest form of the BASIC IF, ie IF ... THEN GOTO, the structured IF of Fig. 4 can be implemented as:



These days most BASICs come complete with a full

IF ... THEN ... ELSE ...

form of the IF statement which is the exact equivalent of Fig. 4. An important point to notice is that if the list of statements following the THEN or the ELSE is very long, it is advisable to turn them into subroutines.

Although you can write any BASIC program using just these forms of flow of control, it would be silly to ignore the very convenient FOR loop. You can use the FOR loop to repeat a list of statements a

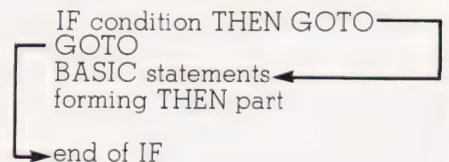
known number of times. SP does place a couple of restrictions on the way you can use a FOR loop, for example, you should not jump to a statement that is in a FOR loop nor jump out of a FOR loop before it is completed.

The 'one statement' IF

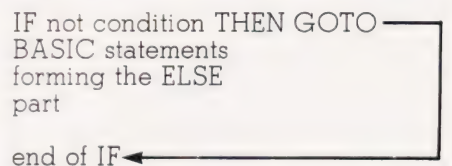
There is a simpler form of the IF statement which is well known to BASIC programmers. It is the one that carries out a statement if the condition is true and skips to the next statement if it is false, ie

IF condition THEN statement
rest of the BASIC program

This is just a special case of the general IF with no statement following the ELSE. However, this 'single statement' form of the IF is more difficult to handle than it looks. For example, the one statement IF can be constructed from the two statement form of the IF simply by not writing any statement in the ELSE part:



But this can be simplified by changing the condition to 'not condition' and leaving the THEN part empty:



In BASIC it is easier to SKIP a list of statements when a condition is false than to carry out the list when a condition is true.

For Example ...

At this point, an example is long overdue. It might be thought that the best sort of example would be one that introduced two programs — one written in free style spaghetti and the other doing the same thing but well structured. In practice though, a program that is long enough to show the full horror of free style programming is too long for the newcomer to SP to appreciate what is going on in the structured version. Instead, a short program illustrating the use of the BASIC equivalents of the WHILE, UNTIL and IF will be given. If you

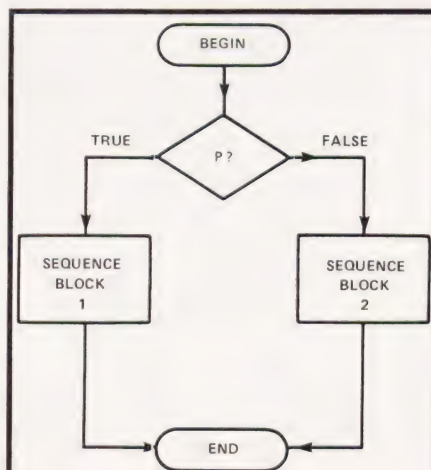
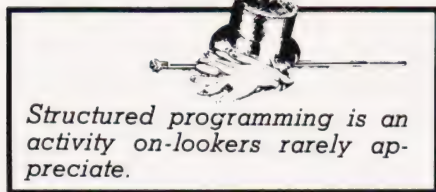


Fig. 4. The conditional branch structure.

ELEGANT PROGRAMMING

want to see the transformation that SP can bring to a spaghetti program then I would urge you to convert an existing program and see for yourself how much more clearly you understand the program and appreciate the method.



Structured programming is an activity on-lookers rarely appreciate.

The example given below is a simple sorting program. Given an array A of size N, it sorts the contents into ascending order using a technique known as a bubble sort. The array is scanned and adjacent elements (ie A(I) and A(I+1)) are compared. If they are in the wrong order then their contents are swapped. The array is fully sorted when no swaps are made during a complete scan.

A structured BASIC program to implement this method is given below. Notice that the lines of BASIC that correspond to the tradi-

tional structured flow of control are indicated.

```

10 DIM A(N)
   :
   :
   :
50 K=0
60 I=1
70 IF I>=N THEN GOTO 170
80 IF A(I)>A(I+1) THEN GOTO 110
90 I=I+1
U N W 100 GOTO 160
T H I 110 T=A(I)
I I F 120 A(I)=A(I+1)
L L 130 A(I+1)=T
E 140 K=1
150 I=I+1
160 GOTO 70
170 IF K<>0 THEN GOTO 50
180 ...REST OF PROGRAM
    
```

The IF in the middle of the program compares the two adjacent elements. If they are in the wrong order, the 'THEN' part swaps them and increments the index I. If they are in the correct order, then the 'ELSE' part simply increments the index I. The WHILE carries out the scan of the array A. As long as the index is less than N then the IF will be carried out (ie the loop continues WHILE I<N). The UNTIL is responsible for the repetition of the scan until no swaps are made. The variable K is set to zero inside the UNTIL and remains zero unless a

swap occurs when it is set to 1. Thus, if a swap is made, K is not zero and the scan is carried out again.

There are a number of things that can be done to improve the readability of this program. For example, as we know how long the array A is, the WHILE loop can be replaced by a FOR loop. That is, instead of line 70, write:

```
70 FOR I=1 TO N-1
```

and remove lines 90 and 150 and replace 160 with NEXT I. Remember that this program is an illustration of SP methods and not necessarily the only way it should be written.

Programming Style

Now that you know something of structured programming you should try to write a some programs taking particular care over how you handle the flow of control. As you gain experience, you do not have to feel that you are forced to apply structured programming as if it were a straight jacket. What is important is that you understand the ideals of good programming style.

Remember, bugs love spaghetti!



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Devising a program from scratch to perform a single task is one of the best ways of learning. We look at a real-life example.



I do *not* play Golf! It has always seemed to me that some hobbies are incompatible with computing, but Golf is surely incompatible with all known human activities other than drinking!!

It was therefore with some alarm, not to say fear of infection, that I greeted a golf addict who announced that he wished to discuss computers. He explained that there were many activities around the clubhouse that clearly called for the use of a computer and to this end he had recently purchased an 8K OHIO machine. Unfortunately, due to the pressures of work (and Golf) he had not yet had time to plug it in, let alone spend the couple of weeks necessary to master the art of programming. The big annual Golf tournament was due in four weeks and he wished to commission a program to help with the difficult task of scoring. (If you look up the word 'commission' in your dictionary, you will find that it does not necessarily involve payment!)

The Specification

Fortunately (he explained) the program would be straightforward, the specification being as follows:

1) There would be up to 200 competitors.

2) For each competitor the following details would be entered in the computer.

Player's Name.

Handicap (H).

Total strokes for first nine holes (front nine F9).

Total strokes for last nine holes (back nine B9).

How many holes took only two strokes.

Whether the player was a club member or a visitor.

3) The computer would then sort this out and announce the first few places in each of the various prize categories:

The Best Round (Nett) (This takes account of the players handicap and is $F9 + B9 - H$)

The Best Round (Gross) ($F9 + B9$)

Best Front Nine (F9)

Best Back Nine (B9)

Best Round (Nett) Club Player

Best Round (Gross) Club Player

Most Two's

He also requested that the program be ready as soon as possible!

The Dialogue

I explained that what he required was not possible on an 8K machine as it could not hold all the necessary data.

He said that perhaps he had not made the position clear. The task of sorting out the score cards by hand was truly terrible. The program he needed would be of immense benefit to at least six people and would be a giant step forward for mankind.

I explained that what he required was not possible on an 8K machine as it could not hold all the necessary data.

He said that he had been given to understand that I was quite good at programming. (He curled his lip contemptuously.)

Afraid for my reputation, I suddenly had a flash of inspiration. All the data that he had mentioned consisted of whole numbers, each less than 256!! POKEd directly into RAM this would not take up too much space. Eyeing him sternly, I told him that whether he liked it or not, there was simply not enough room in memory — each player would have to be allocated a number, names could not be entered.

He agreed that this was an acceptable limitation. It would take all the hard work out of the job of sorting, although it was a pity, because it would have been nice to see all the winner's names on the screen. He apologised for misunderstanding my comments but, he had gained the mistaken impression at first that I was suggesting that the whole thing was impossible!

A Digression Of Sorts

I didn't really mind attempting the program for him. I have a UK101 which is very similar to his computer, particularly as both machines are modified for 32 lines of 48 characters and are fitted with the CEGMON Monitor. You might also say that I was into sorting as I

A CLUBHOUSE SPECIAL

had been experimenting with sorts of various kinds. However, this would be the first practical use of one of the more complicated types and I wasn't quite clear how I would sort a set of data for any one of six different characteristics.

You may care to experiment with the program Comparison Of Sorting Methods which generates a number of random strings and then sorts using any one of four different sorting methods. However, you will find that once the number of items to be sorted gets very large, say more than 100, the bigger programs have to be used if the sorting time is to be kept reasonably short. A simple sort like Straight Sort looks at all the members of the array to find the next, until all are in order. First, it looks at N items then at (N-1) items, then at (N-2), and so on. Suppose it took one second to look at each item. Then it would take $1+2+3+4+5 \dots$ all the way up to N seconds. The difference between sorting 100 and 101 items would be 101 seconds! You can see why this process becomes unacceptable even at real-time intervals.

The better sorting methods like Quicksort and Heapsort take a time period which is proportional to number to be sorted, so that if it takes 30 seconds more to sort 300 than 200, it will take 30 seconds more to sort 400 than it did 300. (It may not seem quite like this on your computer because you will probably be working with a restricted memory space and your computer will keep taking time off to tidy up the workspace.) This process is often referred to as garbage collection and on some machines the software for carrying out the operation has been found to be defective.

If you have any problems in this area then they will be revealed by the sorting program; they will result in either a program crash or in delays of many minutes. Start with a small number of items so that you will learn what to expect. It is interesting to use a stopwatch and plot graphs. You will soon come to appreciate which sort to use for a given task. All of the sort programs are given in a form for sorting strings, but they can be easily changed for numbers by simply changing the string variables to ordinary variables.

Getting back to Golf!

The first job was to add a few more items to the specification:

- 4) The program should be

virtually fool proof. No dropping out at INPUT statements. (He wasn't getting *me* down to the clubhouse. First thing you know I'd be swapping my EPROM programmer for a stripey umbrella.)

- 5) The data must be protected and capable of being saved and re-used with this or other programs. (*Not* written by me.)

- 6) Unlike some of my earlier programs, this one would be properly planned with flowcharts and, and ... Oh well, I could always tidy it up afterwards.

People tell lies, you know, about Systems Analysis, flowcharts, structured programming and the like. They lead you to believe that such methods will actually produce a program rather like a sausage machine produces sausages. The truth is that no flowchart or philosophical discussion ever produced anything worthwhile that wasn't known in the first place. You can bet your sweet life that Archimedes shouted Eureka! before he wrote anything down, and Einstein wasn't doodling with tensor calculus when he cottoned on to Relativity — he went looking for it, just to prove that which he already knew to the rest of us bums. I'd seen how to POKE the data into RAM and I could see how to do the rest of the program except for two things: how to sort for any one of six characteristics and how to handle the INPUTs in a BASIC program.

Playing With It

I was sitting in the computer club playing God, that is to say I was altering a game so that I could win. The people with the games units may have better graphics but they miss out Olympus-wise. (A program doesn't know it's been altered, does it? Think about that tomorrow when you're having your breakfast — someone up there may have altered your program!) Then up comes young Jeremy.

"What shall I do now" said Jeremy. I explained about not dropping out of INPUT statements.

"Do me a subroutine" I said, "It must accept only certain inputs from the keyboard. All the numbers, the letters Y and N, and the Return key. Let it come back with a string when it gets a Return." He ran off to his computer. The lad is only 13 and obviously a genius. We manage to conceal this from him by the usual

tricks; mostly we pretend that he doesn't understand what we are talking about. One day he will probably write a useful new computer language, but only if we can prevent him from going off half cocked. He returned with the subroutine in 10 minutes! Sigh ...

"I put in the Rubout key as well" he said, "Did you want me to put in the Rubout key?"

"Well, of course" I replied. "Now go and see if you can improve this Disassembler program." Jeremy's subroutine starts at line 6000 and if it will not work on your computer, you could always replace GOSUB 6000 with INPUT A\$:P=VAL(A\$).

Blocking Bytes

I had decided that I would arrange the data in memory in blocks of 256 bytes. The first block starting at \$1A00 would store details of the players handicap. I would keep them in order so that the handicap of player number 7 would be at the location \$1A07. Successive blocks would contain F9, B9, 2s and flags to indicate club membership. As I only needed to sort for the best 10 or so, I could initialize the RAM by setting all of these locations to 255. This would mean that if a player did not take part, his score would be automatically set high and would not appear on the screen.

If data is arranged in the form of a string, it is possible to sort for MID\$ or RIGHT\$ combinations, and I could see that it would be possible to do something similar with a 256 by 6 array. The trouble was that there would not be room in memory for such an array. I didn't care for the idea of trying to shuffle the data around in the blocks either, it would take too much time and in any case, it is much more useful to keep them in the order of player's numbers.

I wonder if you have seen the answer while I have been beating about the bush? Look at it this way ... suppose we want to sort for the best B9. Then move the B9 data into A(N) and sort. Let us say that the best B9 is 31 so that $A(1)=31$, great, but which player is this? We don't need the actual scores, what we really need at this stage is the player's numbers in the correct order for the best B9. Given that order we can easily get all the players details and put them on the screen! So, this is what we must do:

Transfer the data to be sorted into A(N)

Set up another array G(N) so that it contains the players numbers. At first G(1)=1, G(2)=2, etc.

Then we sort A(N) but each time we rearrange the data we also move the corresponding player's number. So that at the end of sorting, G(N) contains the new order of players.

We can then throw away the data in A(N) and announce the winners.

The Nineteenth Hole

I hope that you find the program to be of interest and can adapt it for other purposes. My golfing friend tells me that it was a success; although if several players got the same score, it was necessary to refer to the score cards and break the tie by other rules, and it would be nice

to have just the winner's names on the screen, and there is a problem in setting handicaps ... sigh.

If you are looking for program

ideas then you might take a walk down to your local golf club. But be warned, it's rather like getting your leg caught in a mangle.

Program Notes:

- Line 30 Sets up USR(X) vector to FDOO Hex which gets a character from the keyboard.
- Line 40 Memory limit - protects the data stored at the top of memory.
- Lines 50-60 X1 to X6 are the start of each of the six pages of data. The last page is not used in this program.
- Lines 80-100 Not essential to the operation of the program but useful in that it reduces the sorting time.
- Lines 140-160 Check to see if the last location is set to FF Hex (256) indicating that data is present. If not, initialize the memory by setting locations to FF Hex. This allows the entry of previously recorded data and has the advantage that the data is not lost following a Reset and RUN instruction.

Program Listing

```

10 REM ** COMPARISON OF SORTING METHODS
20 PRINT CHR$(26);:REM ** CLEAR SCREEN
30 INPUT "HOW MANY ITEMS";N
40 DIM A$(N),B(INT(LOG(N)/LOG(2)+1),2)
50 FOR I=1 TO N
60 FOR K=1 TO 10
70 A$(I)=A$(I)+CHR$(65+INT(RND(8)*26))
80 NEXT K
90 PRINT I;A$(I)
100 NEXT I
110 PRINT:PRINT
120 PRINT "WHICH SORT":PRINT:PRINT
130 PRINT "[7 SPC]1 ----- QUICKSORT"
140 PRINT:PRINT
150 PRINT "[7 SPC]2 ----- HEAPSORT"
160 PRINT:PRINT
170 PRINT "[7 SPC]3 ----- SHELL SORT"
180 PRINT:PRINT
190 PRINT "[7 SPC]4 ----- STRAIGHT SORT"
200 PRINT:PRINT
210 INPUT OK
220 ON OK GOSUB 320,540,840,740
230 FOR I=1 TO N
240 PRINT A$(I)
250 NEXT I
260 GOTO 950
270 REM ** QUICKSORT
280 REM ** MAIN PROGRAM TO CONTAIN:
290 REM ** DIM A$(N),B(INT(LOG(N)/LOG(2)+1),2)
300 REM ** FOR N ITEMS. A$(0) NOT USED
310 REM ** QUICKSORT ROUTINE
320 S=1
330 B(1,1)=1:B(1,2)=N
340 L=B(S,1):R=B(S,2):S=S-1
350 I=L:J=R:X$=A$(INT(RND(8)*(R-L)+0.5)+L)
360 IF A$(I)<X$ THEN I=I+1:GOTO 360
370 IF X$<A$(J) THEN J=J-1:GOTO 370
380 IF I>J THEN 400
390 W$=A$(I):A$(I)=A$(J):A$(J)=W$:I=I+1:J=J-1
400 IF I<=J THEN 360
410 IF J-L>=R-I THEN 450
420 IF I>=R THEN 440
430 S=S+1:B(S,1)=I:B(S,2)=R
440 R=J:GOTO 480
450 IF L>=J THEN 470
460 S=S+1:B(S,1)=L:B(S,2)=J
470 L=I
480 IF L<R THEN 350
490 IF S>0 THEN 340
500 RETURN
510 REM ** HEAPSORT
520 REM ** SORTS A$(1) TO A$(N)
530 REM ** HEAPSORT ROUTINE
540 M=N:FOR L=INT(N/2) TO 1 STEP-1
550 B$=A$(L):I=L
560 J=I+1:IF J>M THEN 610
570 IF J=M THEN 590
580 IF A$(J+1)>A$(J) THEN J=J+1
590 IF B$>A$(J) THEN 610
600 A$(I)=A$(J):I=J:GOTO 560
610 A$(I)=B$:NEXT
620 L=1:FOR M=N-1 TO 1 STEP-1
630 B$=A$(M+1):A$(M+1)=A$(1):I=L
640 J=I+1:IF J>M THEN 690
650 IF J=M THEN 670
660 IF A$(J+1)>A$(J) THEN J=J+1
670 IF B$>A$(J) THEN 690
680 A$(I)=A$(J):I=J:GOTO 640
690 A$(I)=B$:NEXT
700 RETURN
710 REM ** STRAIGHT SORT
720 REM ** ALSO CALLED BUBBLE SORT
730 REM ** STRAIGHT SORT ROUTINE
740 T1=N
750 F1$=A$(T1):FOR I=0 TO T1-1
760 IF A$(I)<F1$ THEN 780
770 F2$=F1$:F1$=A$(I):A$(I)=F2$
780 NEXT
790 A$(T1)=F1$:T1=T1-1:IF T1>1 THEN 750
800 RETURN
810 REM ** SHELL SORT
820 REM ** SEE ALSO CT FEB '81
830 REM ** SHELL SORT ROUTINE
840 K=N
850 K=INT((K+1)/2):S=N-K
860 FOR I=1 TO S:J=I
870 IF A$(I)<=A$(I+K) THEN 920
880 X$=A$(J):A$(J)=A$(J+K):A$(J+K)=X$
890 IF (J-K)<1 THEN 920
900 IF A$(J-K)<=A$(J) THEN 920
910 J=J-K:GOTO 880
920 NEXT I
930 IF K>1 THEN 850
940 RETURN
950 END

```

The Comparison of Sorts program

```

10 REM ** GOLF TOURNAMENT SCORING PROGRAM
20 REM ** ORIGINATED ON UK 101
30 POKE 11,0:POKE 12,253
40 POKE 129,255:POKE 130,25:POKE 133,0:POKE 134,26
50 X0=255:X1=6656:X2=6912:X3=7168
60 X4=7424:X5=7680:X6=7936
70 PRINT CHR$(26):PRINT:PRINT:PRINT:PRINT
80 PRINT "[3 SPC]HOW MANY PLAYERS ARE TAKING PART"

```

A CLUBHOUSE SPECIAL

```

90 PRINT
100 PRINT "[3 SPC]IN THE COMPETITION (UP TO 255) ?";
110 GOSUB 6000:PRINT CHR$(26):N=P
120 IF A$="" THEN RUN
130 IF N<4 OR N>255 THEN RUN
140 IL=PEEK(8191)
150 IF IL=255 THEN 170
160 FOR I=0 TO 1535:POKE I+X1,X0:NEXT I
170 DIM A(N),G(N)
180 PRINT CHR$(26);
190 PRINT:PRINT
200 PRINT " SELECT:-"
210 PRINT:PRINT:PRINT
220 PRINT "[9 SPC](1) --- ENTER SCORES"
230 PRINT
240 PRINT "[9 SPC](2) --- BEST ROUND (NETT)"
250 PRINT
260 PRINT "[9 SPC](3) --- BEST ROUND (GROSS)"
270 PRINT
280 PRINT "[9 SPC](4) --- BEST F9"
290 PRINT
300 PRINT "[9 SPC](5) --- BEST B9"
310 PRINT
320 PRINT "[9 SPC](6) --- BEST ROUND (NETT) CLUB"
330 PRINT
340 PRINT "[9 SPC](7) --- BEST ROUND (GROSS) CLUB"
350 PRINT
360 PRINT "[9 SPC](8) --- MOST TWOS"
370 PRINT
380 PRINT
390 PRINT " ? ";:GOSUB 6000
400 PRINT CHR$(26);
410 IF P<1 OR P>8 THEN 180
420 ON P GOTO 430,790,830,870,900,930,950,970
430 PRINT "[4 SPC]+++++ ENTER SCORES +++++"
440 PRINT:PRINT:PRINT
450 PRINT " TO EXIT THIS ROUTINE PRESS RETURN"
460 PRINT:PRINT
470 PRINT " TO CORRECT A MISTAKE RE-ENTER ALL DETAILS"
480 PRINT:PRINT:PRINT:PRINT
490 PRINT " PLAYER NUMBER (1 TO";N;") ? ";
500 GOSUB 6000:U1=P:PRINT:PRINT
510 IF A$="" OR A$="Y" OR A$="N" THEN 180
520 IF U1>N OR U1<1 THEN 180
530 PRINT " HANDICAP[19 SPC]? ";
540 GOSUB 6000:U2=P:PRINT:PRINT
550 IF A$="" OR A$="Y" OR A$="N" THEN 180
560 IF U2>24 OR U2<0 THEN 180
570 POKE X1+U1,U2
580 PRINT " WHAT WAS F9[16 SPC]? ";
590 GOSUB 6000:U3=P:PRINT:PRINT
600 IF A$="" OR A$="Y" OR A$="N" THEN 180
610 IF U3>99 OR U3<10 THEN 180
620 POKE X2+U1,U3
630 PRINT " WHAT WAS B9[16 SPC]? ";
640 GOSUB 6000:U4=P:PRINT:PRINT
650 IF A$="" OR A$="Y" OR A$="N" THEN 180
660 IF U4>99 OR U4<10 THEN 180
670 POKE X3+U1,U4
680 PRINT "HOW MANY TWOS[15 SPC]? ";
690 GOSUB 6000:U5=P:PRINT:PRINT
700 IF A$="" OR A$="Y" OR A$="N" THEN 180
710 IF U5<0 OR U5>9 THEN 180
720 POKE X4+U1,X0-U5
730 PRINT " A CLUB MEMBER (Y OR N)[5 SPC]? ";
740 GOSUB 6000:U6=P
750 IF A$="" THEN 180
760 IF A$="Y" THEN POKE X5+U1,1
770 IF A$="N" THEN POKE X5+U1,X0
780 PRINT CHR$(26);:GOTO 430
790 PRINT "[5 SPC]+++++ BEST ROUND (NETT) +++++"
800 FOR I=1 TO N
810 A(I)=PEEK(X2+I)+PEEK(X3+I)-PEEK(X1+I)
820 NEXT:GOSUB 9000:PRINT:GOTO 5000
830 PRINT "[6 SPC]+++++ BEST ROUND (GROSS) +++++"
840 FOR I=1 TO N
850 A(I)=PEEK(X2+I)+PEEK(X3+I)
860 NEXT:GOSUB 9000:PRINT:GOTO 5000
870 PRINT "[6 SPC]+++++ BEST F9 +++++"
880 FOR I=1 TO N:A(I)=PEEK(X2+I)
890 NEXT:GOSUB 9000:PRINT:GOTO 5000
900 PRINT "[6 SPC]+++++ BEST B9 +++++"
910 FOR I=1 TO N:A(I)=PEEK(X3+I)
920 NEXT:GOSUB 9000:PRINT:GOTO 5000
930 PRINT "[5 SPC]+++ BEST ROUND (NETT) CLUB PLAYER ++"
940 FL=1:GOTO 800
950 PRINT "[4 SPC]++ BEST ROUND (GROSS) CLUB PLAYER ++"
960 FL=1:GOTO 840
970 PRINT "[6 SPC]+++++ MOST TWOS +++++"
980 FOR I=1 TO N:A(I)=PEEK(X4+I)
990 NEXT:GOSUB 9000:PRINT:GOTO 5000
5000 REM ** DISPLAY LEADING PLAYERS
5010 PRINT "[4 SPC]PLAYER[5 SPC]H'CAP[2 SPC]F9[2 SPC]B9
[2 SPC]2'S[2 SPC]GROSS[2 SPC]NETT"
5020 PRINT "[4 SPC]-----
-----"

```

```

5030 PRINT
5040 CP=0
5050 FOR I=1 TO N
5060 Z1=PEEK(X1+G(I)):Z2=PEEK(X2+G(I))
5070 Z3=PEEK(X3+G(I)):Z4=X0-PEEK(X4+G(I))
5080 Z5=PEEK(X5+G(I))
5090 IF Z1>24 THEN 5160
5100 IF FL=1 AND Z5<>1 THEN 5160
5110 CP=CP+1:IF CP>10 THEN 5160
5120 PRINT
5130 PRINT 'TAB(5);G(I);TAB(15);Z1;
5140 PRINT TAB(21);Z2;Z3;"[SPC]";Z4;"[2 SPC]";Z2+Z3;
5150 PRINT "[3 SPC]";Z2+Z3-Z1
5160 NEXT:FL=0
5170 X=USR(X):GOTO 180
5999 REM ** INPUT SUBROUTINE
6000 A$=""
6010 X=USR(X):P=PEEK(533)
6020 IF P=13 THEN 6080
6030 IF P=95 THEN 6090
6040 IF P=89 OR P=78 THEN A$=CHR$(P):PRINT A$:RETURN
6050 IF (P>57) OR (P<48) THEN 6010
6060 A$=A$+CHR$(P)
6070 PRINT CHR$(P);:GOTO 6010
6080 P=VAL(A$):RETURN
6090 IF LEN(A$)=0 THEN 6010
6100 IF LEN(A$)=1 THEN A$="":GOTO 6070
6110 A$=LEFT$(A$,LEN(A$)-1):GOTO 6070
9000 REM ** HEAPSORT OF A(1) TO A(N)
9010 FOR I=1 TO N:G(I)=I:NEXT I
9020 M=N:FOR L=INT(N/2) TO 1 STEP-1
9030 B=A(L):B1=G(L):I=L
9040 J=I+1:IF J>M THEN 9090
9050 IF J=M THEN 9070
9060 IF A(J+1)>A(J) THEN J=J+1
9070 IF B>=A(J) THEN 9090
9080 A(I)=A(J):G(I)=G(J):I=J:GOTO 9040
9090 A(I)=B:G(I)=B1:NEXT
9100 L=1:FOR M=N-1 TO 1 STEP-1
9110 B=A(M+1):B1=G(M+1):A(M+1)=A(1):G(M+1)=G(1):I=L
9120 J=I+1:IF J>M THEN 9170
9130 IF J=M THEN 9150
9140 IF A(J+1)>A(J) THEN J=J+1
9150 IF B>=A(J) THEN 9170
9160 A(I)=A(J):G(I)=G(J):I=J:GOTO 9120
9170 A(I)=B:G(I)=B1:NEXT
9180 RETURN
9200 END

```

The Clubhouse Special listing





ZX-81

**QS DEFENDER.**

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QS CHRS BD./

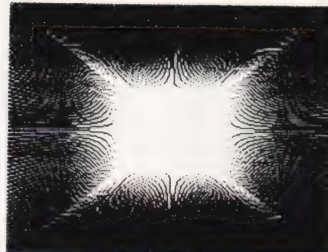
A programmable character generator giving - 128 SEPARATELY PROGRAMMABLE CHARACTERS. ON/OFF SWITCH. 1K ON BOARD RAM. Enables creation and display of your own characters to screen or printer. Demo cassette of fast machine code operation routines and lower case alphabet included. See below for ZX PRINTER listing. **£26.00.**

QS - LOWER CASE

abcdefghijklmnopqrstuvwxy

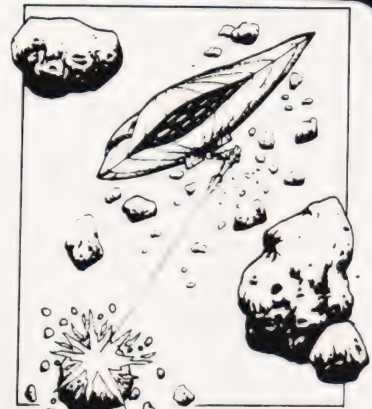
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ZX-80

**QS ASTEROIDS**

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Software to drive QS SOUND BD. Multiple missiles firing in 8 directions. On screen scoring. Increasing number of asteroids. Full mobility of ship to all areas of the screen. Two asteroid sizes. Bonus ship at 10,000 points. Requires 8K ROM, 4K min of RAM + SLOW function. **£5.50.**

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An extremely reliable static RAM Bd. which combines with the computer's memory to give 4K total. Plugs direct in to the rear port on your ZX Computer **£15.00.**

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A reliable expansion system allowing a total of any RAM pack plus two other plug in boards to be in use at once. On board 5V regulator drives all external boards. Fitted with two 23 way double sided edge connectors. Connector is 2x23 way edge conns soldered back to back. Expansion can operate in two ways - (1) COMPUTER ↔ CONNECTOR ↔ Any QS add on bd. (but no extra RAM pack). (2) COMPUTER ↔ CONNECTOR ↔ MOTHER BD ↔ ANY RAM PACK. (2 bds to fit in mother bd.) Mother board **£12.00** Connector **£4.00.**

Special offers & news

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CT982

NEWBRAIN REVIEWED

Mike James

The thinking man's computer? We put this re-launched micro through its paces, or perhaps we should say thoughts!



There are two types of new machine appearing on the market at the moment. The first is large, powerful and often makes a feature of having a 16-bit microprocessor hidden inside. The second is small, includes attractions such as colour graphics, sound output and game paddles or joysticks, and is aimed at the personal home/game playing section of the market. The NewBrain appears to fall into this latter category in that it is *very* small and supports high resolution graphics. However, if you read its sales literature it claims to be of interest to a wide range of 'serious' users — small businesses, education, scientific laboratories etc. Also, if you look at its range of expansion accessories then you have to agree that, if things go according to plan, the NewBrain could grow into a very powerful system. What this means is that it is difficult to compare the machine with others on the market — it may be the first 'small big machine'!

This is probably not an accident. The NewBrain has been a long time in the pipeline and, if it had been produced when its existence was first revealed (about two years ago), it would have stood a good chance of capturing the market that is now dominated by the ZX81, VIC and ATOM. Indeed, if it was to try to compete directly with the new and lower priced, Spectrum over the coming months I doubt that it would fare very well. The actual story of the NewBrain's development is a long and well known story.

Briefly, it is out of Sinclair, through Newbury Labs and on to Grundy Business Systems and almost became the BBC Micro at one point.

The only obvious legacy of its route to existence is its name — NewBrain, which presumably stems from Newbury Labs involvement. I make mention of its name again only to be able to report that when I said in passing to a colleague, that I was expecting to get a NewBrain quite soon, he remarked that this was going a bit too far and that a second hand one would be enough of an improvement! To compound my embarrassment over the name, when the package did arrive it had 'NewBrain — open with care' scrawled on the outside, a message which worried our local postman no end!

The Users' View

The NewBrain is remarkably small, measuring a slight 27 mm by 15 mm by 5 cm: it is important to realise that this does not include the power supply which is contained in an external 15 cm by 8 cm by 7 cm case. This trick of not including power supplies in the main case seems to be a trend that is catching on as a way of decreasing the apparent size of a machine (see the TI-99/4A for example) but in the NewBrain's case, there does seem to be the justification that it can run off batteries and hence the power supply can be dispensed with. There are two models, the A and the AD and the only difference is that the AD has a built-in 16-character, 14-segment fluorescent display.

The first thing that strikes you about the NewBrain is its odd looking 'keyswitch' style keyboard. If you look carefully you will find that all the keys you need are present — Shift, Control, Repeat and cursor controls — but it *looks* strange. However, apart from the short space bar, the keyboard is a standard typewriter layout and the spaces between all the keys are the same as on any typewriter. The difference is simply that whereas most keyboards have tapered keys that almost touch at the base, the NewBrain has square keys with worrying gaps — but in use it feels much like a standard keyboard and a typist should have no difficulty in using it.

The only other external feature that concerns the user is the row of connectors to be found at the rear of the machine. These consist of: two tape recorder interfaces; a bi-directional serial modem interface; a uni-directional serial printer interface; a video output; a UHF output; an expansion bus connector and a power connector. All of the connectors are male 'multi-pin' of a type that I am unfamiliar with in these sizes. However, they are of good quality so my only reservation is about their availability from sources other than Grundy.

Getting started is very simple and involves connecting to a standard TV or monitor and plugging in the power supply. I say plugging in the power supply because the NewBrain does not have an ON/OFF switch. This is probably due to the difficulty in switching the three voltages supplied by the external power supply. However, whatever the reason, unplugging the NewBrain from the mains cannot be regarded as a good way of switching it off and an on/off switch should be added to later models. When the NewBrain is switched on, the screen does nothing for a slightly worrying 10 seconds while the operation system checks that everything is OK. From then on you are running BASIC and can enter, run, save and load programs.

The screen format is either 40 or 80 characters to a line and can be changed under software control. The character set contains a staggering 512 characters including 96 upper and lower case ASCII/ISO printing characters, 64 Viewdata

graphics, Western European accented characters, full Greek upper and lower case, games graphics, etc... Of course, you can only use 255 of these at a time but even so this is an impressive list. You can also mix text and high resolution graphics of 250 dots vertically by either 256, 320, 512 or 640 dots horizontally. There is currently no colour and no sound. (Indeed using the NewBrain was one of the quietest computing experiences I have ever had — not even a keyboard bell broke the silence!) The lack of colour and sound and the presence of an 80 column screen reinforces the idea that the NewBrain is aimed at 'serious' users. The screen quality and the style of the upper and lower case characters is very good and the overall 'user impression' is one of quality.

The NewBrain has two cassette ports and a lead is provided terminated by three jack plugs that will suit most tape recorders. Each port includes independent motor control, a feature that will please anyone thinking of taking cassette operation seriously. The speed of operation is claimed to be 1200 baud (approx 120 characters per second) but it seems slower than this. From my initial investigations, the reliability of data storage seems good. The system worked at a wide range of recorder volume settings and read errors were rare. One welcome feature is the VERIFY command which can be used to check that a program has been SAVED correctly. My only real criticism is the lack of any 'getting on with it' messages during a tape operation.

The Hardware

The NewBrain's circuit boards are packed concertina-fashion, rather like a three-sheet fold-out advertising leaflet. There are three of them — keyboard plus one line display, memory and main processor board — joined together by soldered ribbon cable and folded back on one another to form a neat stack. The quality of construction is good although there are signs of last minute modifications in the form of jumper wires on the main board and resistors directly soldered to chips on the memory board. None of the chips apart from the Z80 itself is socketed. The most notable thing about the design of the NewBrain is that there are very few LSI chips present. There are a large number

of standard 74 series TTL chips used instead. This is not to say that the design is old-fashioned, just that Grundy have avoided the gamble of using specially build ULA chips that has paid off so handsomely for Sinclair and Acorn. To emphasise this point, the main logic board has around 70 TTL chips whereas the Spectrum or the ZX81 pack most of this into one large chip! This philosophy of 'do it with TTL' even extends to the serial interfaces.

The printed circuit board forming the keyboard is unremarkable apart from the drive circuitry for the fluorescent display. A small 'piggy back' board provides the necessary high voltage to drive the display. The one line display is clear and not too difficult to use. It cannot display all the characters that the NewBrain contains but it does make applications packages for use away from a TV set or monitor possible.

As mentioned, the main board carries a very large number of chips including the Z80 microprocessor which is a Z80A double speed device. To confirm that the NewBrain is a modern design, the system software is contained in three 2764 EPROMs giving a combined 24K. A 2732 EPROM is used as a character generator and this accounts for the other 4K bytes of the 28K of ROM claimed in the summary at the end of this article. The only other point worth mentioning is the COP 420 four-bit controller which contains its own 1K of program in ROM and is responsible for looking after the keyboard, the cassette interfaces and the single line display on the Model AD.

The memory board is small and contains sixteen MM5290 memory chips which are 4116/150ns dynamic RAMs by any other name!

Overall the hardware of the NewBrain is traditional in implementation but shows a good deal of modern design — I have to add that my opinion is based on very little technical information supplied by the manufacturer. For example, there are references to memory paging options but I have no idea how such memory paging might be carried out. There may be more that I have failed to uncover!

The BASIC

Although the expanded NewBrain can be thought of as a multi-language machine, most users are bound to treat it, at least at first,



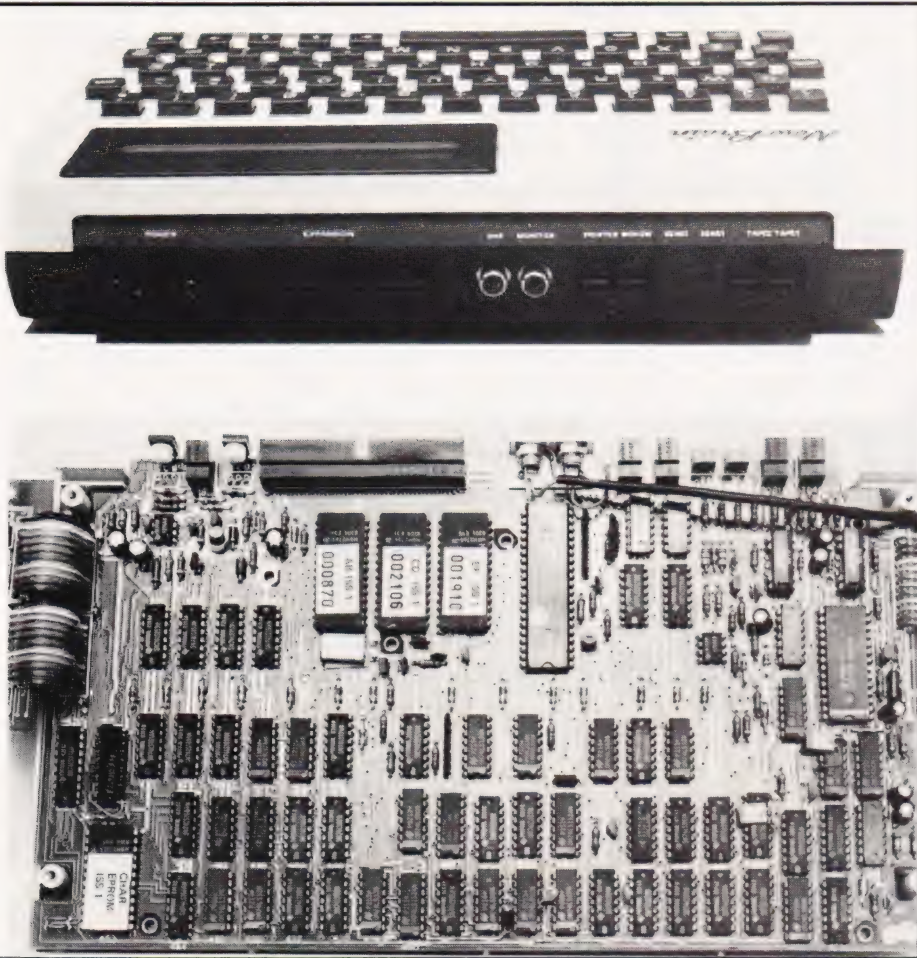
Above: The NewBrain driving a monitor and showing off one of its character sets.

Top right: All the I/O you could possibly expect... and even more is available in plug-in modules.

Right: The main PCB revealing a large collection of chips.

as a BASIC machine. Rather than use a modified version of Microsoft BASIC, Grundy have written their own Z80 ROM BASIC. Writing your own BASIC is bound to cause some problems with compatibility with the rest of the world because there is always the temptation to improve on what has gone before. This is fine if the result *is* an improvement but it can sometimes be difference for difference sake. After all, if your new BASIC is going to be exactly like Microsoft BASIC then why not save yourself the trouble and sign a licensing agreement with Microsoft. Grundy have tried to avoid this problem of 'which' BASIC by adopting, and then enhancing, the ANSI standard BASIC. This shows a certain amount of good sense in that Grundy cannot be held responsible for any little changes brought about by the ANSI standard and in theory everyone *should* be using ANSI BASIC. In practice this is not the case. The *de facto* standard for BASIC *is* Microsoft and it will be a long time before this changes. (And if it does change, it is likely to be due to the increased popularity of another BASIC, Sinclair BASIC

NEWBRAIN REVIEWED



say, rather than the voluntary adoption of a standard). Following these comments it is fortunate that I can announce that NewBrain BASIC is very like Microsoft BASIC after all!

It only has two data types — six digit reals and strings that can be as long as 32767 characters! Arrays can be real or string and can be as large as memory allows (ie 5575 elements with the standard 32K system) but they are limited to one and two dimensions only. The BASIC is a little odd in that it includes some advanced features such as ON ERROR and ON BREAK but misses others. For example, there is only IF...THEN and no IF...THEN...ELSE! One statement that is worth noting is CLEAR 'variable list' which releases the memory space used by all the variables in 'variable list'. This makes the creation, deletion and re-creation of arrays possible. Other differences from Microsoft are fairly superficial — you must name the index variable in a NEXT, INPUT "prompt" takes the form INPUT ("prompt"), and only single parameter user-defined functions

are allowed. Perhaps the most important area of compatibility is string handling and NewBrain BASIC uses all the 'standard' Microsoft string functions, ie LEFT\$, RIGHT\$, MID\$ and INSTR. There is one strange concession to Microsoft users, namely that you can use a '?' in place of PRINT.

The manual and advertising literature claim that the new BASIC is a compiler or a dynamic compiler. However, on reading more carefully, I noticed words like 'entokened' which suggest that it is actually an interpreter. The distinction between a compiler and an interpreter is largely an academic one but I doubt that NewBrain BASIC compiles to Z80 machine code. A technical note refers to the object code as taking the form of one byte operators (Y-codes) which index a table of run-time routines (X-routines). If this is the case then NewBrain BASIC works in the same way that Microsoft BASIC does and Microsoft call their product an interpreter! What really matters is not so much the question of compiler or interpreter but how fast does it

go? With a multiply taking only 10 mS it *is* fast and this should mean that it is up to most demands that applications are likely to make.

Other Software

The NewBrain BASIC is only part of the software that is supplied in ROM. There is also a text editor which is used by BASIC to edit programs, a graphics package and the operating system which looks after all the I/O.

The text editor is advanced in the sense that it includes features such as on-screen inserts, line and character deletes. It is more than adequate for editing BASIC programs and can be used as the basis of a good text processing facility.

The graphics package is implemented as two extensions to BASIC: the PLOT statement and the PEN function. PLOT is used to control the movement of a graphics 'pen' which can either leave a mark or not. The form of the command is PLOT 'plot list' where 'plot list' is a list of graphics instructions to do things such as move the pen or plot a single dot. The range of instructions that can be incorporated into the 'plot list' is quite wide and includes some advanced features such as 'arc', to draw part of a circle and 'axis', to draw a crossed x,y axis including interval marks! The PEN function is used to discover where the pen is and what the current value of any screen point is. It should be possible for anyone who can understand BASIC to make use of the extra graphics commands to produce good displays. One or two of the commands have bugs in them of a very minor nature such as not working if the angle is specified in degrees.

Although I have many ideas about what the NewBrain's operating system does, most of them have the status of vague suppositions. The reason for this is the lack of any really coherent explanation of what it does in any of the literature that came with the review machine. It is certainly responsible for looking after the I/O via device drivers and this is a fairly normal function for the operating system in a micro to do. However, it also seems to carry out a certain amount of memory management and this is a more unusual feature to find in a micro.

The manual also makes mention of the ROM software being easily

NEWBRAIN REVIEWED

extended — 'Programs in RAM or ROM can replace or extend programs already present in ROM. In particular, additional features can be added to NewBrain BASIC without having to replace the original ROMs'. Obviously if this is the case it will be important in many applications but until Grundy come up with more information I cannot comment.

Documentation

The complete handbook for the NewBrain was sent to me hot off the press just a few days before the final copy deadline. It starts off with a 'getting going' section and an introduction to NewBrain BASIC. This part of the handbook is well written with plenty of examples and should enable a beginner to cope with the machine and BASIC. Things are not as good, however, when more advanced topics are discussed. Chapter Ten on graphics is too short and has too few examples to enable a beginner to cope with the NewBrain's extensive facilities. The brief style continues in Chapter 11 — 'Help in an emergency' and the manual finishes with nine copious appendices. The manual is good as far as it goes but for anyone wanting to use the NewBrain to the full there is a serious information shortage. This may be temporary because in the handbook's preface, two other manuals are referred to — the NewBrain Beginners Guide and the NewBrain Software Technical Manual.

Expansion

The range of expansion options must be one of the strongest reasons for considering a NewBrain as opposed to any other machine. The advertising literature mentions the following expansion items — an expansion box including memory paging; parallel input and output ports; analogue ports; V24 serial ports and extra ROM sockets; memory expansion modules containing 64K, 128K, 256K or 512K bytes; multiple communications module; disc memory module; Teletext/Prestel module and battery back up. So far though, prices are only given for the expansion module, the memory modules, the battery back up and the V24 serial box. I cannot vouch for the availability or delivery dates for any of the add-ons but if Grundy can deliver all it describes then the NewBrain is indeed a large machine. The prices of all the extras are very reasonable and this cer-

tainly indicates that there is no intention of selling a low cost machine only to make vast profits selling the extras that make it worth having. The 64K of memory for £75 is particularly remarkable and raises the question (once again) of what sort of profit margin everyone else is selling memory at!

Some readers may be wondering what use can be made of the vast memory sizes offered by the expansion modules.

Using memory paging, a Z80 can give the impression of being able to address more than 64K by swapping blocks of memory in and out of the same address regions. The only trouble with this method is that only software that has been specially written can make use of this feature — if the software doesn't know about memory paging then it can only use 64K. Grundy tell me that the NewBrain BASIC knows about memory paging and this means that you should be able to write BASIC programs that essentially can make full use of up to 2M!!!

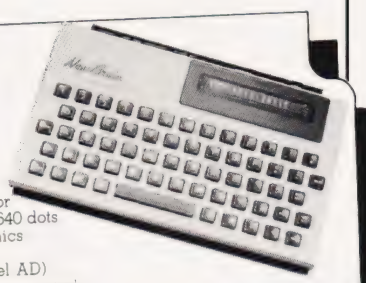
Apart from the large quantities of memory that can be added, it will also be possible to add floppy disc drives.

Expansion software includes CP/M for the disc drives, Z80

assembler, COMAL, a simple stats package and a text processor. An important factor is whether or not the extra software will be able to use the memory paging. I have been told that CP/M will not (it would be unreasonable if it did) but NewBrain BASIC and thus BASIC programs running under CP/M will.

Conclusion

The NewBrain is a difficult machine to sum up. As a single unit it provides a high quality, low cost alternative to machines such as the VIC and the Spectrum. As a fully expanded machine it rivals (and possibly exceeds) machines such as the SuperBrain and the Tandy Model III. The option of a one-line display and the availability of a battery pack opens up the possibility of using the NewBrain away from 'base' and brings it into competition with machines as diverse as the Osborne 1 and the Sharp PC-1500. The NewBrain cuts across so many neat categorisations of current machines that it is almost impossible to predict how it will fare. Computers can no longer be expected to sell themselves so it will all depend on marketing and the extent to which Grundy can really support it with add-ons and extras.



FACTSHEET	
CPU	NewBrain Z80A
Clock	4MHz
ROM	28K
RAM	32K
Language	NewBrain BASIC
Keyboard	62 key standard layout with a short space bar
Display	25 lines by 40 or 80 characters on TV or monitor Bit mapped graphics, 250 by 256, 320, 512 or 640 dots 512 characters including Viewdata block graphics Black and white display only Single line 16 character display optional (Model AD)
Cassette I/O	1200 baud dual interlace with independent motor control Uni-directional serial Bi-directional serial
Options	System bus £80.00 Expansion Module £45.00 Battery Module £75.00 Memory Expansion 16K £135.00 128K £245.00 256K £445.00 512K £145.00 V24 expansion 8channel £255.00 16channel £457.00 32channel NYA
Costs	Disc module NYA Videotext module NYA NewBrain A £199.00 NewBrain AD £229.00
Supplier	Grundy Business Systems Ltd Somerset Road Teddington Middlesex TW11 8TD 01-977 1171

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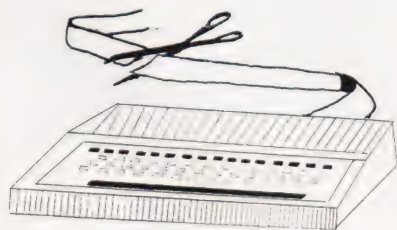
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6800 Text Processor, with Source Listing,	28.00	32.50
6800 Relocator, with Source Listing,	16.09	18.50
6800 8K Basic Interpreter (V2.3),	15.22	17.50
6809 Text Editor, Cassette to Cassette,	32.61	37.50
6809 Macro Assembler, Memory to Cassette,	32.61	37.50
6809 10.5K Basic Interpreter,	48.70	56.00

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More enquiries and interesting titbits for the Editor to cope with!

What nicer way could there be to start off one's regular column in the magazine by saying Thank You? This sudden display of gratitude is aimed at all those people who took the time and trouble to write and call in offering their copies of certain magazines to replace my missing file issues. First in with an offer was Roger Keyworth who supplied the missing edition of Your Computer, lots of you seemed to want to get rid of that particular magazine... wonder why?

Sadly, no one had a spare copy of the first ever Practical Computing (I'm still hoping!) but Larry Mascall who, judging by his office address might glow a little in the dark, kindly sent in a complete photocopy. The man is obviously not quite with it as he asked for some of our very rare back issues. We sent them and he politely returned them having copied the bits he wanted! My thanks to both of you for sterling service and a general thank you to all the others who offered magazines.

Are POKEs Really Safe?

Remember back in the July issue I answered an enquiry on the subject of POKEs? Well, it's egg-on-face time again. I stated that you could happily POKE around any machine without causing damage - well, that's what I thought until the following arrived!

In the July edition of #FILE you mentioned that there are no POKEs that could damage a machine. Well, there is one known to cause damage. It applies to 12" screen Commodore machines, the 8032/8096 and the Yat' 40s. If you POKE 59458,62 on early machines such as the 2001, 3000 and 4000 series, the speed of printing on the screen speeds up by a factor of six and this was used in commercial software until it caused trouble with the newer, bigger screened machines. To quote Jim Butterfield: "The damage is not immediate, the screen picture collapses or diminishes and eventually a curl of smoke comes from the machine...". Other sources put the problem down to a 5 V rail being forced to ground. That's what I call a crash!

The author of the letter asked to remain anonymous - he seemed rather worried that the local Commodore boys might suddenly descend upon him. If anyone else out there knows of any similar disasters waiting for the unwary programmer to unleash them please let me know - I'm just grateful the guy who asked the question owned a Sharp and, as he hasn't written back, he's either happy or speechless!

The Great Rip Off

About once or twice a year the news comes in of yet another case of software being sold by unauthorised outlets and the threats of legal action start to fly. This time around it's a load of VIC material which someone appears to have bought in good faith only to find that the person who sold it to him didn't have any right to it at all. While I'm not about to go into my usual tirade on software protection, it does make one wonder just how much original software there is and how much of the so-called original material is simply ripped off.

Take, for example, all the programs we publish. Now, legally the copyright of all these programs belongs to the publisher but how many of these have found their way into software suppliers' lists? The sad thing is that it is often not the fault of the software house. They buy the programs in and pay a royalty to the 'author' for each copy they sell. Many of them even insist that the 'author' signs a declaration stating that if there is found to be a breach of copyright then the blame lies with him and not the software house.

We try to keep a fairly close eye on the software lists, just to see what might have come from us. However, as there is just so much new software pouring onto the market each week, the task has become almost impossible. The only way one finds out is when a reader calls in to let you know or a supplier checks up on his author. Perhaps now is the time to call on the only trade body currently in operation, the Computer Retailers Association, to take a serious look at the subject of software rip-off and to take one or two offenders to task as examples. Perhaps we could take a leaf out of the video industry's book which has been suffering a similar problem with pirated films. Their solution

was not to prosecute on single charges but to collect evidence on a number of offences and then join forces and prosecute as a joint body.

Whatever the suggestions, I think now, rather than any later, is the time to start taking some serious action. If any readers have serious comments on this or further suggestions on the subject, please let me know and I'll pass them on the CRA. Who knows, something might actually get done!

The Great Systems War

We are now just over half way through the year, at least we are as I write this from the middle of a pile of packing cases and jumbled books - yes, I've just moved house. What has the year brought us so far? Well, we've had The Computer Programme but not very many BBC Micros, we've had the Falklands crisis and a whole bunch of 'Zap your most unfavourite South American republic' games, and we've had Uncle Clive's annual present to the world and that too was beset with delivery difficulties and a nasty little bug in the works. We finally got the NewBrain and that worked; my review Sirius finally arrived without the manuals and the only thing that it would do was talk to me and the *last* thing I wanted it to do was talk to me! Most of Atari's UK people went to other companies but none went to Osborne which was surprising considering how well the 'just-about' portable is doing. On the whole a better than average year really!

Well, so far that is. What is to come in the next six months? There's Acorn's Electron, Commodore's new range of systems to replace the rather long in the tooth PET, the Dragon which might be a 'Tandied' Tangerine, an unspecified object from Binatone for less than £50, the IBM Personal Computer - I'm putting my money on September as the launch month for the UK - and, doubtless some surprises from our much maligned oriental brethren who seem to be about the only people who are taking a really long term approach to the whole affair.

The final word this month must, however, go to one of our longest rivals in the magazine market, PersonalComputerWorld. All the best to them, especially Peter Rodwell, their Editor, with the new organisation.

Don't let its size fool you.

If anything NewBrain is like the Tardis.

It may look small on the outside, but inside there's an awful lot going on.

It's got the kind of features you'd expect from one of the really big business micros, but at a price of under £200 excluding VAT it won't give you any sleepless nights.

However, let the facts speak for themselves.

You get what you don't pay for.

NewBrain comes with 24K ROM and 32K RAM, most competitors expect you to make do with 16K RAM.

What's more you can expand all the way up to 2 Mbytes, a figure that wouldn't look out of place on a machine costing ten times as much.

We've also given you the choice of 256, 320, 512 and 640 x 250 screen resolution, whereas most only offer a maximum of 256 x 192.

Big enough for your business.

Although NewBrain is as easy as ABC to use (and child's-play to learn to use) this doesn't mean it's a toy.

Far from it.

It comes with ENHANCED ANSI BASIC, which should give you plenty to get your teeth into.

And it'll also take CP/M® so it speaks the same language as all the big business micros, and feels perfectly at home with their software.

NO OTHER MICRO HAS THIS MUCH POWER IN THIS MUCH SIZE FOR THIS MUCH MONEY.



So as a business machine it really comes into its own.

The video allows 40 or 80 characters per line with 25 or 30 lines per page, giving a very professional 2000 or 2400 characters display in all on TV and/or monitor. And the keyboard is full-sized so even if you're all fingers and thumbs you'll still be able to get to grips with NewBrain's excellent editing capabilities.

When it comes to business graphics, things couldn't be easier. With software capabilities that can handle graphs, charts and computer drawings you'll soon be up to things that used to be strictly for the big league.

Answers a growing need.

Although NewBrain, with its optional onboard display, is a truly portable micro, that doesn't stop it becoming the basis of a very powerful system.

The Store Expansion Modules come in packages containing 64K, 128K, 256K or 512K of RAM. So, hook up four of the 512K modules to your machine and you've got 2 Mbytes to play with. Another feature that'll come as a surprise are the two onboard V24 interfaces.

With the aid of the multiple V24 module this allows you to run up to 32 machines at once, all on the same peripherals, saving you a fortune on extras.

The range of peripherals on offer include dot matrix and daisy wheel printers, 9", 12" and 24" monitors plus 5 1/4" floppy disk drives (100 Kbytes and 1 Mbyte) and 5 1/4" Winchester drive (6-18 Mbytes).

As we said, this isn't a toy.

It doesn't stop here.

Here are a couple of extras that deserve a special mention.

The first, the Battery Module, means you won't be tied to a 13 amp socket. And, even more importantly, it means you don't have to worry about mains fluctuations wreaking havoc with your programs.

The ROM buffer module gives you a freedom of another sort.

Freedom to expand in a big way. It gives you additional ROM slots, for system software upgrades such as the Z80 Assembler and COMAL, 2 additional V24 ports, analogue ports and parallel ports.

From now on the sky's the limit.

Software that's hard to beat.

A lot of features you'd expect to find on software are actually built into NewBrain so you don't need to worry about screen editing, maths, BASIC and graphics.

However, if you're feeling practical you can always tackle household management, statistics and educational packages. And because NewBrain isn't all work and no play, there's the usual range of mind-bending games to while away spare time.

Waste no more time.

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QUIZ TIME

A multiple choice test program that's been proved in the classroom.

We all know that the SI unit of current is the Ampere but do you know the name of the unit of luminous intensity and are you sure you can spell the name of the unit of conductance correctly? If the answer is no, then your friendly computer will prompt you with the answer so that by the second or third re-run, your score should have increased significantly until eventually you achieve a perfect score. If you are a high scorer anyway you can still use the quiz to help sharpen your keyboard response in your attempt to obtain a fast time.

Scoring And Timing

Out of a possible 24 questions in this quiz, only 20 are asked at any one session and these are chosen and presented in a random order. This makes it impossible for you to obtain a high score and a fast time simply by remembering the order of the answers. A note is kept by the computer as each question is asked so that repetition is avoided; this is the function of the array A(). The method of scoring is as follows: you are allowed two attempts at each question and score five or three marks for a correct answer at your first or second attempts respectively. If you are wrong at your second go or if you reply with 'D' (for don't know) then you are given the correct answer but are still asked the question again to help you to fix the answer in your mind. A correct reply at this stage is worth one mark but if you are careless and give the wrong answer you will incur a penalty of minus one!

While that explains the scoring of a normal run you may, if you wish, exit from the program by typing 'X' and for that question you will score minus three marks. After the normal 20 questions or after an 'X' reply you will be shown a list of the unasked questions so that you can test yourself on these as well but without the benefit of the model answers. There is one further penalty which will be incurred by anyone asleep at the keyboard. After a don't know reply to a question you are told the correct answer — so if you give a 'D' reply a second time to the same question, you will be given a penalty of minus five marks to help wake you up!

```
PLEASE TYPE YOUR NAME? HENRY
PLEASE TYPE YOUR COURSE CODE OR S FOR
STAFF? S
DO YOU WISH TO BE GIVEN INFORMATION ON
THE QUIZ? █
```

```
Q 5 NAME THE UNIT OF MASS
YOUR ANSWER ? POPOTUI
OH DEAR! PLEASE CONSULT YOUR LECTURER OR
LOOK UP THE REFERENCE
SCORE -1
```

```
Q 6 NAME THE UNIT OF TIME
YOUR ANSWER ? SECOND
YOUR FIRST ATTEMPT IS WRONG. TRY AGAIN
```

```
Q 6 NAME THE UNIT OF TIME
YOUR ANSWER ? MINUTE
YOU NEED HELP!
THE CORRECT ANSWER IS SECOND
I WILL REPEAT THE QUESTION
```

```
Q 6 NAME THE UNIT OF TIME
YOUR ANSWER ? █
```

```
THANK YOU HENRY
FOR ATTEMPTING THIS QUIZ
YOU ATTEMPTED 20 QUESTIONS
YOUR OVERALL SCORE IS 22 OUT OF A
POSSIBLE 100
YOUR TOTAL RESPONSE TIME WAS 782.4
SECONDS
PRESS SPACE BAR TO CONTINUE
```

Typical screen displays from the Quiz Time program.

The normal total score will lie between 20 and 100 but you should get 90 or more after two runs. At this point your aim should be 100% in a fast time. The method of timing used in this quiz is to add up your individual response times to each question — the time taken by the computer to present each question is *not* included. The total time

recorded is rounded to the nearest tenth of a second and you can use this, together with the score, to check your progress. If you have a printer then you can receive a certificate which includes a record of your score and speed.

The printer used to produce this certificate was the CBM 4022; you may have to modify subroutine SR5

if you use a different model. The printer is, of course, an optional extra in this program and may be omitted altogether by deleting lines 790 to 810 in the main program and deleting the whole of SR5.

A problem common to many interactive programs is that of a program crash which occurs if, in response to an INPUT statement, the Return key is hit before any other key. In a quiz this mistake would be very tiresome, particularly if the participant was half way through the questions. To prevent this crash, line 3060 has been modified and line 3070 added in SR3. If now, in response to 'YOUR ANSWER?', the Return key is hit then the underline will prevent a program crash. If, however, a normal answer is typed then the first character will replace the underline and a simple comparison with the model answer can take place.

Changing The Questions

The questions in this SI quiz all require single word answers which must be spelt correctly. It is a simple task to modify the program so that questions are asked on an entirely different topic provided that you can keep to the same format of single word answers. An obvious alternative quiz of this type would include questions and answers such as:

WHAT IS THE CAPITAL OF FRANCE?

If you look at line 3040 you will see that each question is a concatenation of a fixed part (Q1\$) and a variable part (Q\$). The variable part of the questions and the model answers are stored in the DATA statements which are very easy to change. If, for some reason, it is necessary to present the questions in a predetermined order then line 3030 together with SR6 should be deleted. It would, however, be a relatively simple matter to change the program so that one of several predetermined selections was chosen at random on each run.

Suppose, however, you wish to accept two or more correct answers. Clearly all the acceptable answers must be included in your DATA statements and the READ statement in line 6030 of SR6 must be changed as well as the test for the correct response in line 3100. If some of your questions have one correct answer while others have two or

more than a further modification is necessary to allow for these variations. Including null strings in the data would be one of several ways of doing this.

A word of warning should be heeded by those of you who wish to create a new set of questions. Make sure that your questions are not ambiguous and also double check on the correctness of your model answers. It is a good idea to shelter behind the protection of an established authority on the subject. In the SI quiz, my reference is the well known book **Physical Constants** by Kaye and Laby (14th Edition).

The Program

Even if you are not interested in this kind of quiz I hope that you may find some useful programming ideas. First, you must decide precisely what it is you wish the program to achieve. The outline scheme for this quiz, but not all of the detail, has already been described. Now examine the main program flowchart (Fig. 1) and you will see that most of the detailed programming is put into the subroutines. A subroutine is a module which can be designed and tested as an entity and used in other programs if required. The subroutine will operate in any program subject only to the correct transfer of data to and from the subroutine. This method of design is to be recommended because it is easier to achieve high reliability and good maintenance, that is, the ability to modify the program to meet new conditions with no or few faults. Debugging a new program is easier too!

It is highly desirable that the user should be given sufficient information on the screen to enable him to use the program correctly. On the other hand, not all of the information need be repeated on each re-run and a choice is given to the user, such as in line 700, which may save much frustration. The time taken to read a screen page of information varies considerably from user to user and depends, in part, on previous usage. For this reason, information should not be presented for a fixed time; instead, the user should be given a simple instruction which, when carried out, 'turns' the page. In this quiz the instruction used is 'PRESS SPACE BAR TO CONTINUE' but, as you will see from lines 1080 and 1090 in SR1, the program would continue if

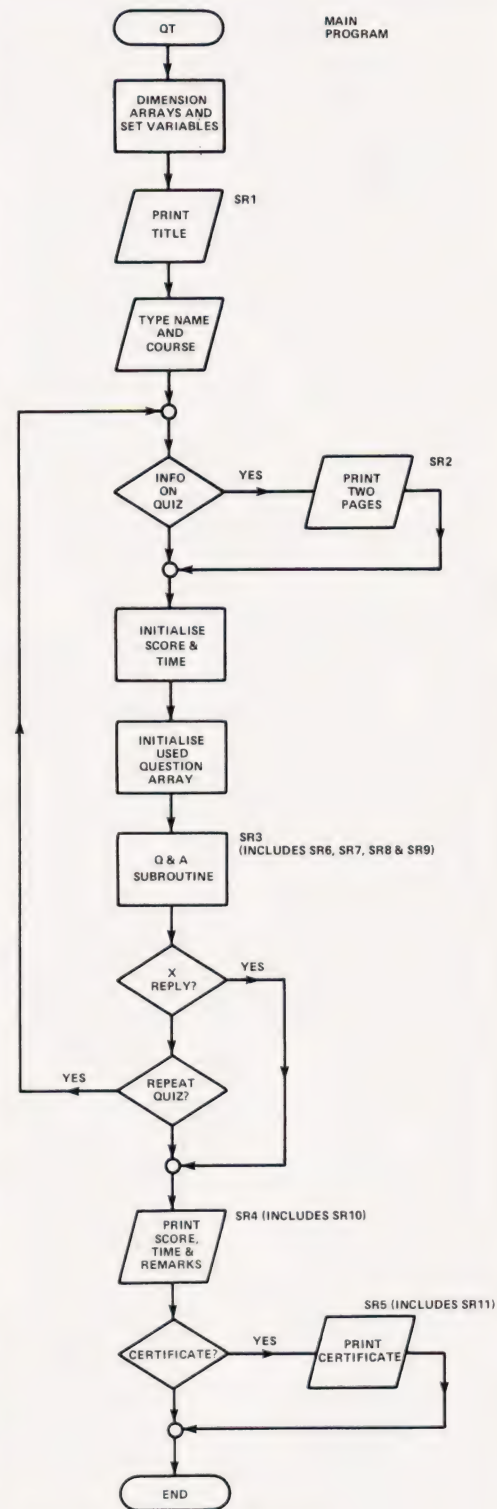


Fig. 1. The main flowchart.

any key is pressed. The reason for giving the specific instruction rather than the more general 'PRESS ANY KEY' is that the latter may raise a doubt in the user's mind about the possibility of different effects resulting from pressing different keys.

The three line press space bar

QUIZ TIME

routine occurs a number of times throughout the program and could have been turned into a four line subroutine which was called by a GOSUB on each occasion as required. The message structure and the control structure used in this program could also be simplified if only a single reply to each question is permitted. This, however, is more appropriate to a competitive type of quiz than to a self-learning scheme with rewards and penalties. The variable F is used both for control and for scoring (see SR3).

The variable T is used to sum the total time to reply to each question. This is set to zero at the beginning of

a run (line 320) and is measured in 'jiffies' ('jiffies' are the internal divisions of time on the PET and represent 50ths of a second. Ed.) while the increments of time are being added together. T is finally converted to seconds (rounded to the nearest tenth of a second) in line 3230.

The 4022 printer used in this quiz to produce a certificate has a wide variety of format controls. Use has been made of the control CHR\$(1) in lines 5120, 5130, 5240 and 5370, to change the print size. Clearly these lines may have to be modified to suit the printer available to you.

Running The Program

This is perfectly straightforward, provided that the user follows the screen instructions. Yes/No answers to questions such as DO YOU WISH TO BE GIVEN INFORMATION ON THE QUIZ? may be given in full or abbreviated to Y or N. The program has been tested on many first year students who have used it without supervision. Reactions to the quiz have shown me that many students like this kind of learning process. It is, however, wise to take note of the final message which is to remember that knowing the names of the units is *not* the same as understanding their meaning.

Program Listing

```
180 REM ** INITIALISE VARIABLES AND DIMENSION ARRAYS
190 D=0:REM ** NUMBER OF DON'T KNOWS PER QUESTION
200 F=0:REM ** NUMBER OF ERRORS
210 REM ** F=1 ONE ERROR
220 REM ** F=2 TWO ERRORS OR DON'T KNOW
230 REM ** F=3 THREE ERRORS
240 REM ** F=4 EXIT FROM PROGRAM
250 REM ** F=5 TWO DON'T KNOWS
260 I=0:REM ** I COUNT
270 J=0:REM ** J COUNT AND CONTROL
280 J1=0:REM ** J1 QUESTION NUMBER
290 J2=0:REM ** J2 COUNT UNUSED QUESTIONS
300 K=0:REM ** K RANDOM NUMBER
310 S=0:REM ** S TOTAL SCORE
320 T=0:REM ** T TOTAL RESPONSE TIME
330 T0=0:REM ** T0 RESPONSE START TIME
350 REM ** AS REPLY TO YES/NO QUESTION
360 REM ** CS COURSE
370 REM ** MS MODEL ANSWER
380 REM ** NS NAME
390 REM ** QS QUESTION, VARIABLE PART
400 Q1$="NAME THE UNIT OF "
410 P$="PRESS SPACE BAR TO CONTINUE"
420 REM ** RS RESPONSE TO QUESTION
430 S1$="STAFF MEMBER"
440 S2$="STUDENT"
450 REM ** W$ WAIT FOR SPACE BAR
460 DIM A(24):REM ** USED QUESTION CHECK
470 DIM M$(14):REM ** MESSAGES
480 DIM U$(24):REM ** UNUSED QUESTIONS
490 M$(1)="CORRECT REPLY"
500 M$(2)="NEXT QUESTION"
510 M$(3)="I AM SORRY THAT YOU HAVE GIVEN UP BEFORE THE
END OF THE TEST"
520 M$(4)=" WHY NOT CONSULT YOUR NOTES AND TRY[5 SPC]
AGAIN TOMORROW?"
530 M$(5)="YOUR FIRST ATTEMPT IS WRONG. TRY AGAIN"
540 M$(6)="YOU NEED HELP!"
550 M$(7)="THE CORRECT ANSWER IS "
560 M$(8)="I WILL REPEAT THE QUESTION"
570 M$(9)="OH DEAR! PLEASE CONSULT YOUR LECTURER OR
LOOK UP THE REFERENCE"
580 M$(10)="YOU MUST BE JOKING"
590 M$(11)="THANK YOU"
600 M$(12)="YOU DID NOT TYPE Y. SKIP PRINTOUT"
610 M$(13)=" OUT OF A POSSIBLE 10J"
620 M$(14)=" NOT ASKED THE NAMES OF THE[5 SPC]UNITS
OF "
630 REM ** MAIN PROGRAM
640 GOSUB 1000:REM ** TITLE PAGE SR1
650 PRINT "[CLS][3 CD]"
660 INPUT "PLEASE TYPE YOUR NAME";NS
670 PRINT
680 INPUT "PLEASE TYPE YOUR COURSE CODE OR S FOR[3 SPC]
STAFF";CS
690 PRINT
700 INPUT "DO YOU WISH TO BE GIVEN INFORMATION ON
[2 SPC]THE QUIZ";AS
710 IF LEFT$(AS,1)="Y" THEN GOSUB 2000:REM ** SR2
720 S=0:T=0
730 FOR I=1 TO 24:A(I)=0:NEXT I:REM ** INITIALISE
740 GOSUB 3000:REM ** Q&A SR3
750 IF RS="X" THEN 780
760 INPUT "DO YOU WISH TO REPEAT THE QUIZ";AS
770 IF LEFT$(AS,1)="Y" THEN 700
780 GOSUB 4000:REM ** END SUBROUTINE SR4
790 PRINT
800 INPUT "DO YOU REQUIRE A CERTIFICATE OF YOUR[5 SPC]
SCORE AND TIME";AS
810 IF LEFT$(AS,1)="Y" THEN GOSUB 5000:REM ** PRINTOUT
SR5
820 PRINT:PRINT "END OF PROGRAM. GOODBYE"
830 END
890 REM ** TITLE SUBROUTINE SR1
1000 PRINT "[CLS]"
1010 PRINT "[5 CD][10 CR]";
1020 PRINT "QUIZ TIME"
1030 PRINT "[3 CD]"
1040 PRINT "THIS IS A QUIZ ON THE NAMES OF SI UNITS"
1050 PRINT
1060 PRINT "USE THE QUIZ AS A TEST OF YOUR ACCURACY AND
SPEED"
1070 PRINT:PRINT:PRINT:PRINT PS
1080 GET WS
1090 IF WS="" THEN 1080
1100 RETURN
1990 REM ** INFORMATION SUBROUTINE SR2
2000 PRINT "[CLS]"
2010 PRINT "IN THIS QUIZ YOU WILL BE ASKED 20[7 SPC]
QUESTIONS ";
2020 PRINT "OUT OF A POSSIBLE 24"
2030 PRINT:PRINT "THE QUESTIONS WILL BE PRESENTED TO YOU
[2 SPC]IN A RANDOM ORDER"
2040 PRINT:PRINT "YOU MUST ANSWER EACH QUESTION WITH A
[4 SPC]SINGLE WORD NAME"
2050 PRINT:PRINT "YOUR SPELLING MUST BE CORRECT"
2060 PRINT:PRINT
2070 PRINT "IF YOU DO NOT KNOW THE ANSWER TO A[6 SPC]
QUESTION TYPE D"
2080 PRINT:PRINT
2090 PRINT "IF YOU WISH TO END THE QUIZ TYPE X"
2100 PRINT:PRINT:PRINT
2110 PRINT PS
2120 GET WS
2130 IF WS="" THEN 2120
2140 PRINT "[CLS]"
2150 PRINT:PRINT:PRINT:PRINT
2160 PRINT "YOU WILL SCORE POINTS ON EACH QUESTION
[2 SPC]AS FOLLOWS"
2170 PRINT
2180 PRINT "CORRECT AT FIRST ATTEMPT.....5"
2190 PRINT "CORRECT AT SECOND ATTEMPT.....3"
2200 PRINT "CORRECT AT THIRD ATTEMPT.....1"
2210 PRINT "WRONG AT THIRD AND FINAL ATTEMPT.....-1"
2220 PRINT "PENALTY FOR PREMATURE ENDING OF TEST.-3"
PRINT "PENALTY FOR TWO 'DON'T KNOWS' IN[26 SPC]ONE
QUESTION.....-5"
2230 PRINT:PRINT
2240 PRINT "MAXIMUM MARKS FOR 20 QUESTIONS.....100"
2250 PRINT
2260 PRINT "EACH QUESTION IS TIMED FROM THE END OF
[2 SPC]THE QUESTION PRINTOUT ";
PRINT "TO WHEN YOU HIT[3 SPC]THE RETURN KEY"
2270 PRINT:PRINT:PRINT:PRINT PS
2280 GET WS
2290 IF WS="" THEN 2290
```

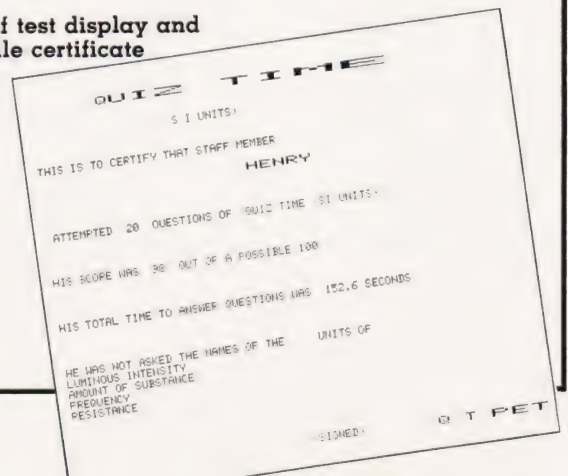
QUIZ TIME

```

2310 RETURN
2990 REM ** Q&A SUBROUTINE SR3
3000 PRINT "[CLS]"
3010 FOR J=1 TO 20
3020 D=0:F=0:J1=J:REM ** INITIALISE QUESTION
3030 GOSUB 6000:REM ** READ DATA IN RANDOM ORDER SR6
3040 PRINT:PRINT "Q";J1:PRINT Q1$+Q$
3050 T0=T1
3060 INPUT "YOU ANSWER [2 CR]_[3 CL]";RS
3070 IF RS=" " THEN PRINT "[2 CU]":GOTO 3060
3080 T=T+T1-T0
3090 PRINT
3100 IF RS=M$ THEN PRINT M$(1):PRINT "SCORE ";5-2*F:
PRINT M$(2):GOTO 3180
3110 F=F+1
3120 IF RS="X" THEN GOSUB 7000:REM ** SR7
3130 IF RS="D" THEN GOSUB 8000:REM ** SR8
3140 IF F=1 THEN PRINT M$(5):GOTO 3040
3150 IF F=2 THEN PRINT M$(6):PRINT M$(7)+M$:PRINT M$(8):
GOTO 3040
3160 IF F=3 THEN PRINT M$(9):PRINT "SCORE -1"
3170 IF F=5 THEN PRINT M$(10):PRINT "SCORE -5"
3180 S=S+5-2*F
3190 NEXT J
3200 PRINT:PRINT P$
3210 GET WS
3220 IF WS="" THEN 3210
3230 T=INT(T/60+0.5)/10
3240 GOSUB 9000:REM ** STORE UNUSED QUESTIONS SR9
3250 IF F=4 THEN J1=J1-1
3260 RETURN
3990 REM ** END SUBROUTINE SR4
4000 PRINT "[CLS]"
4010 PRINT:PRINT:PRINT
4020 PRINT "THANK YOU ";NS
4030 PRINT:PRINT
4040 PRINT "FOR ATTEMPTING THIS QUIZ"
4050 PRINT:PRINT
4060 PRINT "YOU ATTEMPTED ";J1;" QUESTIONS"
4070 PRINT:PRINT
4080 PRINT "YOUR OVERALL SCORE IS ";S;" OUT OF A [7 SPC]
POSSIBLE 100"
4090 PRINT:PRINT
4100 PRINT "YOUR TOTAL RESPONSE TIME WAS";T;"[29 SPC]",
"[3 SPC]SECONDS"
4110 GOSUB 10000:REM ** PRINT UNUSED QUESTION LIST SR10
4120 PRINT:PRINT
4130 PRINT "REMEMBER THAT KNOWING THE NAMES OF THE"
4140 PRINT "UNITS IS NOT THE SAME AS UNDERSTANDING
[2 SPC]THEIR MEANING"
4150 PRINT:PRINT
4160 PRINT "I HOPE THAT YOU ARE HAPPY, WISER OR BOTH"
4170 RETURN
4990 REM ** PRINT CERTIFICATE SR5
5000 PRINT "[CLS][3 CD]"
5010 PRINT "IS YOUR PRINTER CONNECTED, LOADED WITH
[3 SPC]PAPER AND SWITCHED ON?"
5020 PRINT
5030 PRINT "TYPE Y WHEN READY"
5040 GET WS
5050 IF WS=" " THEN 5040
5060 IF WS<>"Y" THEN PRINT M$(12):GOTO 5390
5070 PRINT M$(11)
5080 OPEN 1,4
5090 FOR I=1 TO 10
5100 PRINT#1,CHR$(29);:REM ** LINE FEEDS
5110 NEXT I
5120 PRINT#1,CHR$(1);"Q";CHR$(1);"U";CHR$(1);"I";
CHR$(1);"Z";CHR$(29);:REM ** CHR$(1) GIVES BIG
LETTERS
5130 PRINT#1,"T";CHR$(1);"I";CHR$(1);"M";CHR$(1);"E"
5140 PRINT#1:PRINT#1
5150 FOR I=1 TO 20
5160 PRINT#1,CHR$(29);
5170 NEXT I
5180 PRINT#1,"(S I UNITS)"
5190 PRINT#1:PRINT#1
5200 PRINT#1,"THIS IS TO CERTIFY THAT ";
5210 IF CS="S" THEN PRINT#1,S1$:GOTO 5230
5220 PRINT#1,CS;S2$
5230 PRINT#1
5240 PRINT#1,CHR$(29),CHR$(1),NS
5250 PRINT#1:PRINT#1:PRINT#1
5260 PRINT#1," ATTEMPTED ";J1;" QUESTIONS OF 'QUIZ TIME
(S I UNITS)'"
5270 PRINT#1:PRINT#1:PRINT#1
5280 PRINT#1,"HIS SCORE WAS ";S;M$(13)
5290 PRINT#1:PRINT#1:PRINT#1
5300 PRINT#1,"HIS TOTAL TIME TO ANSWER QUESTIONS WAS ";
T;"SECONDS"
5310 PRINT#1:PRINT#1:PRINT#1
5320 GOSUB 11000:REM ** UNUSED QUESTIONS SR11
5330 PRINT#1:PRINT#1:PRINT#1
5340 FOR I=1 TO 35
5350 PRINT#1,CHR$(29);
5360 NEXT I
5370 PRINT#1,"(SIGNED)";CHR$(29),CHR$(1);"Q T";
CHR$(29);CHR$(1);"PET"
5380 CLOSE 1
5390 RETURN
5990 REM ** READ DATA IN RANDOM ORDER SR6 (SEE SR3)
6000 K=INT(24*RND(0))+1
6010 IF A(K)=1 THEN 6000
6020 FOR I=1 TO K
6030 READ Q$,M$
6040 NEXT I
6050 A(K)=1
6060 RESTORE
6070 RETURN
6990 REM ** EXIT SR7 (SEE SR3)
7000 PRINT "SCORE -3"
7010 J=20:F=4
7020 PRINT M$(3):PRINT:PRINT M$(4)
7030 RETURN
7990 REM ** DON'T KNOW SR8 (SEE SR3)
8000 F=2
8010 IF D=1 THEN F=5
8020 D=D+1
8030 RETURN
8990 REM ** UNUSED QUESTIONS SR9 (SEE SR3)
9000 J=1
9010 FOR K=1 TO 24
9020 READ Q$,M$
9030 IF A(K)=0 THEN US(J)=Q$:J=J+1
9040 NEXT K
9050 J2=J
9060 RESTORE
9070 RETURN
9990 REM ** PRINT UNUSED QUESTIONS SR10 (SEE SR4)
10000 PRINT:PRINT
10010 PRINT P$
10020 GET WS
10030 IF WS="" THEN 10020
10040 PRINT:PRINT "YOU WERE";M$(14)
10050 FOR J=1 TO J2
10060 PRINT US(J)
10070 NEXT J
10080 RETURN
10990 REM ** PRINT UNUSED QUESTIONS ON PRINTER SR11
(SEE SR5)
11000 PRINT#1,"HE WAS";M$(14)
11010 FOR J=1 TO J2
11020 PRINT#1,US(J)
11030 NEXT J
11040 RETURN
20000 REM ** DATA
20010 DATA "LENGTH","METRE"
20020 DATA "MASS","KILOGRAM"
20030 DATA "TIME","SECOND"
20040 DATA "ELECTRIC CURRENT","AMPERE"
20050 DATA "THERMODYNAMIC TEMPERATURE","KELVIN"
20060 DATA "LUMINOUS INTENSITY","CANDELA"
20070 DATA "AMOUNT OF SUBSTANCE","MOLE"
20080 DATA "PLANE ANGLE","RADIAN"
20090 DATA "SOLID ANGLE","STERADIAN"
20100 DATA "FREQUENCY","HERTZ"
20110 DATA "FORCE","NEWTON"
20120 DATA "PRESSURE","PASCAL"
20130 DATA "ENERGY","JOULE"
20140 DATA "POWER","WATT"
20150 DATA "QUANTITY OF ELECTRICITY","COULOMB"
20160 DATA "POTENTIAL DIFFERENCE","VOLT"
20170 DATA "CAPACITANCE","FARAD"
20180 DATA "RESISTANCE","OHM"
20190 DATA "CONDUCTANCE","SIEMENS"
20200 DATA "MAGNETIC FLUX","WEBER"
20210 DATA "MAGNETIC FLUX DENSITY","TESLA"
20220 DATA "INDUCTANCE","HENRY"
20230 DATA "LUMINOUS FLUX","LUMEN"
20240 DATA "ILLUMINANCE","LUX"

```

An end of test display and a facsimile certificate printout.



READ-OUT

For Auntie Beeb's Machine!



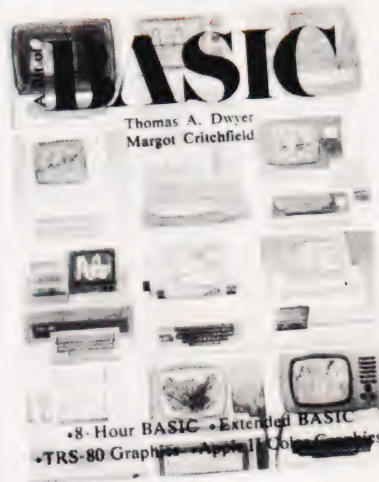
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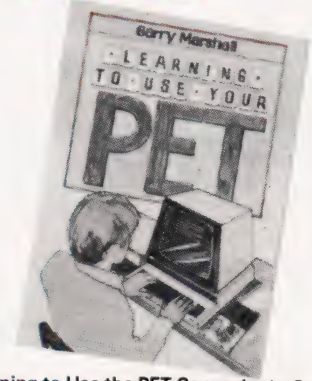
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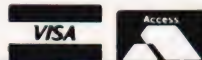
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CE 150 Colour Graphic Printer/Cassette interface (Optional)

Colour Graphic Printer

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Printing digits	Standard 18 digits (36, 18, 12, 9, 7, 6, 5, 4 digits selectable)
Printing system	X-Y axis plotter system
Printing mode	Graph/Text switchables
Character sizes	9 different sizes from 1.2 x 0.8 mm to 10.8 x 7.2 mm (from 1/16" x 1/32" to 7/16" x 9/32")
Printing colours	Red, blue, green, black
Printing directions	Right, left, up, down
Minimum step width	0.2 mm (1/64")
Cassette Interface	Up to two cassette tape recorders can be connected

CE 151 Memory Module (Optional)

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----------	-------------------

CE 155 Memory Module (Optional)

Capacity	8K-byte C-MOS RAM
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BASIC LANGUAGE SPECIFICATIONS

PC 1500

Commands	RUN, NEW, LIST, CONT, TR ON, TR OFF, LOCK, UNLOCK, STATUS, MEM
Statements	INPUT, PRINT, GPRINT, CURSOR, GCURSOR, PAUSE, USING, WAIT, CLS, IF... THEN, STOP, GOTO, ON... GOTO, GOSUB, ON... GOSUB, RETURN, ON ERROR GOTO, FOR... TO... STEP, NEXT, END, DIM, LET, REM, DATA, READ, RESTORE, BEEP, AREAD, ARUN, CLEAR, RANDOM, DEGREE, RADIAN, GRAD, BEEP ON, BEEP OFF
Functions	SIN, COS, TAN, ASN ACS, ATN, LN, LOG, EXP, DEG, DMS, RND, SQR ($\sqrt{\quad}$), SGN, ABS, INT, PI (π), LEFT\$, RIGHT\$, MIDS\$, ASC, VAL, LEN, CHR\$, STR\$, POINT
Variables	A ~ Z, AS ~ Z\$, two-letter variables possible, two-dimensional arrays applicable
Operations	+, -, *, /, (,), >, <, >=, <=, <>, =, ^, AND, OR, NOT, &
Others	INKEY\$, TIME, , ; :

CE 150 Printer

Commands	LLIST, TEST
Statements	LPRINT, TAB, LF, ROTATE, COLOR, GLCURSOR, SORGN, LINE, RLINE, CSIZE, TEXT, GRAPH, LCURSOR

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Commands	CSAVE, CLOAD, CLOAD? MERGE
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When we first brought out our Buyer's Guides, the decision was taken to present all the relevant information in the simplest form possible. We broke the various computers down into their essential components and presented a comparative list. The Guides were not a roaring success!

The reason for their initial failure is now obvious, we didn't explain the meaning of the words we were using, RAM, CPU, I/O, etc and the very people for whom the Guides were intended — the first time buyers — found them very hard to take in. As soon as we had recognized this failing we published explanations to each of the Guides; the result was that they became much more widely used.

Looking at the problems we created for ourselves with those early Guides, it has become very obvious that there is a need for a simple, plain-English explanation of all the technical jargon in use. The last time we published one was back in May 1980 where we featured 100 of the most common pieces of jargon. This new feature is a complete update and will be repeated every few months for our new readers.

Computing Components

Every single computer can be divided up into a number of fundamental segments, this not only makes them easier to understand but also helps us write about them in simpler terms!

The heart of each computer is the **Central Processing Unit** or **CPU**. On large computers this is a vast collection of circuits filling at least an entire printed circuit board and often an entire box. In the world of the personal computer, however, this has all been reduced into the space of a single integrated circuit, the **microprocessor**. This device contains all the necessary logic to take information in, process it according to a set of instructions and pass it back to the outside world. The speed at which it performs these operations is governed by two factors; first, the way in which the device has been made and second, the speed of the **clock**. The clock is simply a very accurate oscillator

which beats millions of times a second; typical speeds are between 1 and 4 million cycles a second (this number is generally expressed as frequency — 2 MHz for example).

The actual logic contained within a microprocessor varies according to the technology available at the time it was designed, but suffice to say that they are more complicated than I would wish to explain on these pages.

The simplest form of computer can be built from a set of switches, a microprocessor with its correct clock circuit, a power supply and a set of lights. If you set up the correct pattern of ons and offs on one set of switches, the device will take in the information presented as an **instruction**. The pattern of ons and offs represents a binary code, each on is regarded as a '1' and each off as a '0'. You could now give it some more information — **data** — then another instruction and, if you were lucky, you would see a **result** displayed on the set of lights. Systems such as this are often used in schools and colleges as basic training aids for students learning about microprocessors; they are not often found in the real world.

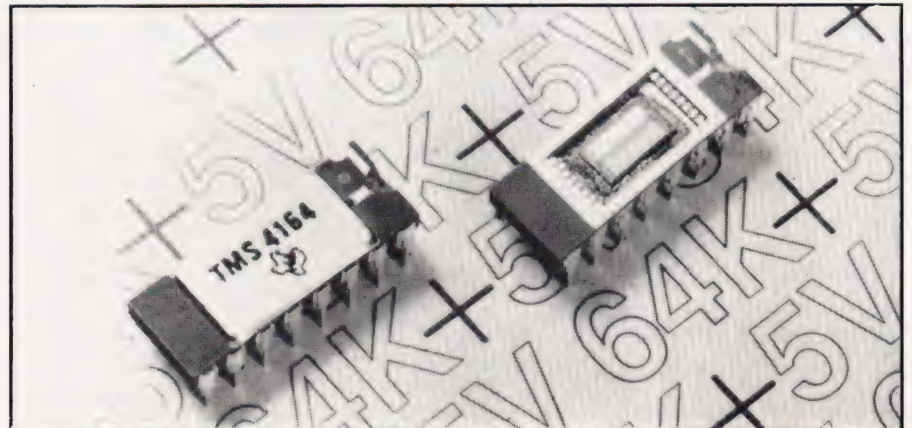
The set of instructions we give the computer is called the **program** and as we have been programming in the simplest possible form, **binary**, we call this **machine code programming**. It is often possible for the user of a microcomputer to program the system in machine code but we very seldom use the binary notation — remembering all those 0s and 1s is not easy. What is

generally allowed, however, is the use of a code system called **hexadecimal**, **Hex** for short. This can be used because virtually all of the common microprocessors use **eight bits** to make up each of the instructions they use (eight bits is called a **byte** and this is the fundamental unit of information as far as the user is concerned). Hexadecimal means '16' so we are therefore working in base 16 arithmetic. This means that any eight digit binary number can be represented by two Hex digits. The letters A to F are used to represent the numbers 10 to 16.

Elephant's Graveyard

It would obviously be very nice to store a set of instructions — the program — somewhere in the computer rather than having to key them in one at a time. The breed of device we use for storage is called **memory** and this can be one of two fundamental types. These are commonly called **Random Access Memory** and **Read Only Memory**, that's **RAM** and **ROM** in the jargon, but these names do not really describe the true workings of their systems.

Random Access Memory comes in two types, **static**, which uses rather a lot of power but is very fast, and **dynamic** which uses less power but pays for this by being somewhat slower. As far as the user is concerned they are identical. Memory areas which are made up of RAM can be written to and read from; information can be stored and retrieved at the programmers wish. However, if you turn off the power the contents



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are lost, fine for temporary information but not so good for programs.

The second type of memory, ROM, comes in many guises but once the information has been stored it is there for good, the user can read it out when required but it cannot be destroyed by turning the power off. This sort of memory is used for all the programs which come built into the computer; these are the programs that you often don't realise are there, such as the program to take a character from the keyboard and the one which displays that character on the screen. All these hidden programs come under the general heading of the **Operating System** or **Monitor**. (The term monitor can also be used for a special type of visual display but in this case it is generally spelt with a small 'm').

All the information stored in memory is held in blocks of eight bits, the byte we mentioned earlier — and each byte corresponds to one single character. Most common computers use a coding system for the numbers and alphabet, and other special symbols called **ASCII** code which stands for the **American Standard Code for Information Interchange**.

Using the binary system where each of the eight bits (a bit is a BInary digiT just as 8 is a decimal digit) can be either 1 or 0, we can have a possible 2^8 combinations or patterns and as the full ASCII set only uses 128 of these, the manufacturers of microcomputers often add extra characters such as special graphics symbols.

The amount of memory a given microprocessor can use is limited by the number of **address** lines. A normal eight-bit micro, generally has 16 address lines and, using the same formula as the ASCII code, we can connect up to 2^{16} or 65,536 bytes of memory. This number is generally referred to as **64K** where the **K** signifies binary thousand or 1024. It is possible to connect more memory to a microprocessor using special techniques but only 64K of this total can be used at any one time.

Peripheral Proliferation

So far we have covered the central processor and the memory but we still can't actually use the computer because we have no way of getting information in or out. Devices such as keyboards and TV sets are the most common and these, together with their more exotic cousins, are all called **peripherals**.

As far as the typical personal computer is concerned, a **key-board**, which looks somewhat like the one you would find on a typewriter but generally with more keys, is used for getting instructions and information into the computer. The computer's processed information, the program you are working on or anything else, is displayed on a **video screen**. This may be your domestic TV or a special video monitor or, in high-class systems, the screen and keyboard may be combined into a single unit called a **Visual Display Unit** or **VDU**. Some complete systems are built into what looks like a large VDU and these are often called **desktop** computers.

The type of display that you get on a TV or video screen varies from system to system but is typically expressed as so many **lines** of so many **characters**, 25 by 40 and 16 by 32 are typical. As well as the supplied graphics characters I mentioned earlier, some systems allow the user to produce true graphics; plot points, draw lines and so on. The capabilities of these systems is generally expressed as the number of **dots** that can be displayed across and down the screen. The larger the numbers, the higher the **resolution** you will be able to obtain. In practical terms this can be demonstrated by getting the system to draw a circle; the higher the resolution the nearer the result will be to a 'perfect' circle.

The keyboard and display are the two most vital components of the system, without them you can't use the computer. However, the computer is capable of being connected to much more exotic devices and the capacity for these connections is referred to as the **Input/Output** or **I/O**. Once again there are many different kinds of I/O connections, generally known as **interfaces** because they form the junction between two separate items. We can break these down into two groups, **serial** and **parallel**. The most common name associated with the former is the **RS232** standard which is used for many of the common peripheral devices such as printers, VDUs and even for connecting between two different computers.

The parallel interface is so called because it allows one entire byte to be transferred at a time, the serial interface transfers each byte bit by bit (that's not a pun either!). Two special sorts of parallel interface are frequently found, the **Centronics** printer interface and the **IEEE-488**

communications interface.

In order to control the way in which information is passed over these interfaces, special control signals are used and these come under the delightful heading of **handshake** lines. The name describes their action exactly.

There is one further type of I/O which is fundamental to the computer and that is the **bus**. This is the collection of interconnections which allows various parts of the computer to share sections of the processor. In many computers they are limited to the main processor board and the memory, but in more recent designs they are often gathered together in some logical order and brought out of the computer so the user may add extra facilities to his basic system. Names such as S-100, S-50, Eurobus, Multibus and a host of others can be found in the literature. In theory, if your computer has a defined bus structure then you can plug in any other extra, such as more memory, built to the same structure and it will work.

Programming The Beast

Earlier in this piece I mentioned that writing programs in machine code (binary) or even their Hex alternatives was somewhat irksome. Well, on many systems you can have a special program fitted into the computer called an **Assembler**. This allows you to write your programs in **assembly code** where you use two- or three-letter words to represent the function you wish to be performed. These are called **mnemonics** and are translated by the assembler program into machine code which the computer can then run.

Programming the computer by these methods is laborious in the extreme and is generally avoided by providing the user with something called a **high-level language**. These are so called because they allow the user to express complex functions, which would otherwise require many hundreds of machine code instructions, in a language not dissimilar from English. The most common of these, at least as far as microcomputers go, is **BASIC**, which is the acronym for **Beginners All-purpose Symbolic Instruction Code**. You'll see a lot of it in its various forms between the covers of this magazine and it is relatively easy to learn and use. The main advantage that it has for the personal computer user is that it is an **interpreted** language; this means that you can easily change things

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around if they don't work or even improve those that do.

An **interpreter** is another program built into the computer which allows you to type in your programs in the high level language. The interpreter quite happily accepts this, stores it away and when commanded to RUN, sets about converting it all into machine code so that the central processor can actually do something with it. All this translation takes time and programs written in this sort of language run considerably slower than their machine code equivalents, so some computer manufacturers offer a special program called a **compiler**. This allows you to develop your program and thoroughly test it using the interpreter and then convert it completely into machine code. You now store away the old program and just use the much faster machine code version.

There are many programming languages; BASIC, Pascal, FORTH, COMAL, ALGOL, FORTRAN, etc, etc and they all have something to offer the user for his or her specialised use. Much argument has raged over good and bad programming techniques and which languages should be used for what but, in general, BASIC can still be regarded as the easiest to use and quickest to achieve results from.

Keeping A Copy

All this talk of writing programs and a glimpse of the pages of BASIC and machine code in this magazine may have awakened a memory of something I mentioned earlier — RAM forgets when you turn the power off. What you really need is some way to store a copy of your program so that you can re-use it at a later date. Storage of this type is called **backing** or **off-line** storage and is generally based on **magnetic** recording techniques. The simplest and cheapest method is the **cassette tape**. In many cases you don't even need a special cassette recorder although digital-quality tape is to be recommended. The system works by converting each bit into one of two **tones**, a high tone if its a 1 and a low tone if its a 0. These are then fed, serially, on to the tape at a given speed. This speed is generally referred to as the **baud rate** but a more accurate definition would be the **bits per second** or **bps**. Obviously, the faster the transfer rate, the less time it takes to save or load your programs, but (relatively) the faster you save, the less reliable the process becomes.

The cassette comes in for much criticism for its slowness but it is unlikely to be superceded at the price for many years to come. The next step up the ladder is still tape-based and is called the **floppy tape** or **stringy floppy**. This is a much smaller and faster continuous loop rather like a miniature eight-track cartridge (remember those?). The real gain for the user is that the unit comes with an Operating System which makes it much easier to use.

Another step up the storage ladder is the **floppy disc**. This comes in two sizes; **5¼"** and **8"** and is rather like one of those flexible gramophone records but made out of the same material as recording tape. This is enclosed in a cardboard envelope and spins round inside a **disc drive**. The information is stored in the disc in concentric rings called **tracks** each of which is broken up into a number of **sectors**. A basic single sided, single density 5¼" floppy disc holds about 200K of information; if you want more room you can go to double density or even quad density, but the remarks I made about fast storage on tape apply here too. Much better, if you can afford it, to use 8" drives.

The Rolls Royce of storage media is the **Winchester disc**. These come in sealed boxes and replace one of your 5¼" or 8" drives. Because the discs inside are rigid, the tolerances to which the unit can operate are much higher and they can often store some 10M (megabytes) of information per 5¼" unit. The price of the unit, currently, is around £2,000.

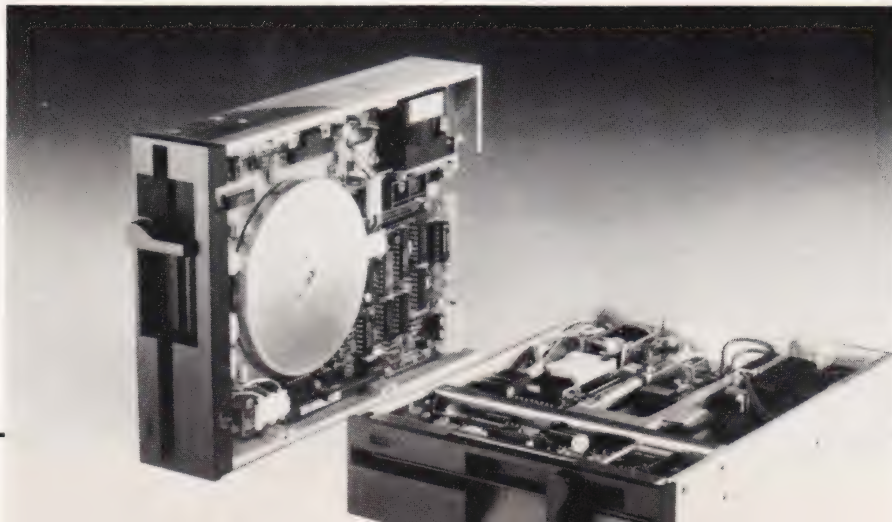
All of these discs have a sophisticated piece of software supplied called a **Disc Operating System** or **DOS**. Typical examples here include CP/M, FLEX and UNIX. These allow the programmer or user to issue a single command such as INITIALISE and the DOS will then perform a complete set of operations to prepare a new disc.

Using The System

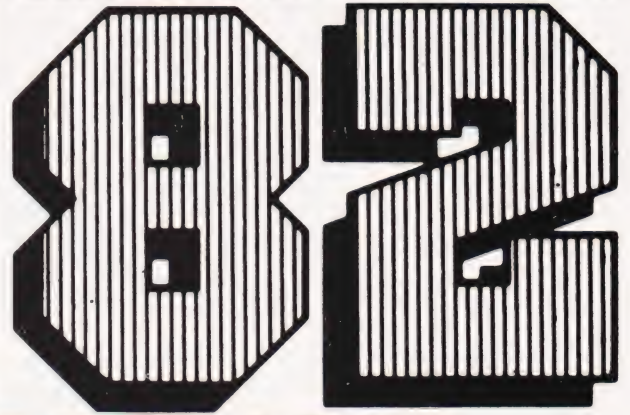
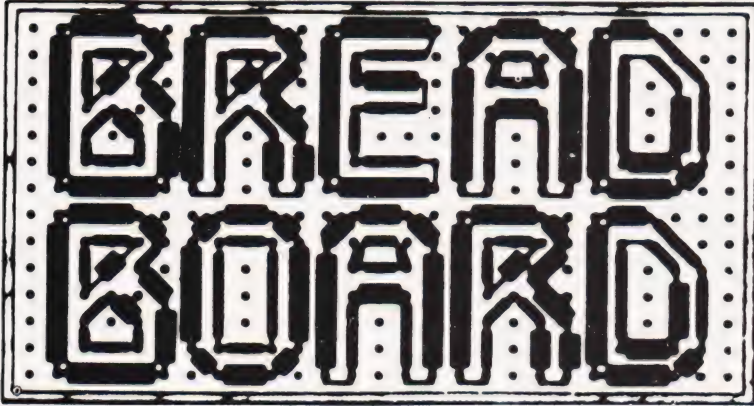
All this stored information is very nice but only being able to read it on a TV screen is a little limiting, words on paper can be more use at times. The printed copy of something held on a computer is known as **hard copy** and you need a printer to get it. Printing devices can be broken down into two fundamental types and two methods of printing. The two types are **impact** and **non-impact**; this simply refers to whether the character is formed by banging something through a ribbon or whether it is created by thermal or electrostatic processes.

The methods most commonly found are **character printing**, this is where a complete character is formed on the paper at one go — just like on a typewriter — and **matrix printing**, where each character is made up from a number of dots. The best quality print comes from an impact character printer and examples of these are the **daisywheel** and **golfball**. The daisy has the letters arranged around the rim of a slitted disc as compared to its close cousin the spinwriter, which uses a cup-like carrier for the letters.

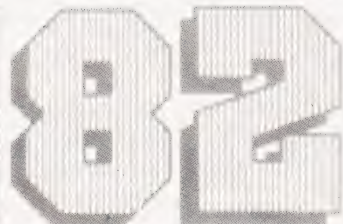
Although the quality of text produced by a matrix printer is not quite as good as that produced by a character printer, it has the considerable advantage of being cheaper and more flexible to use. If you have a system which can produce special graphics characters then unless you want to spend a fortune on having special daisywheels or golfballs made, you need a matrix printer. Each needle of the matrix in the printing head can generally be controlled separately. This allows you to either have your own character set installed in a ROM inside the machine instead of, or in addition to, the one supplied with the machine; or even to control the needles as you are printing and so produce actual copies of the dots on the screen.



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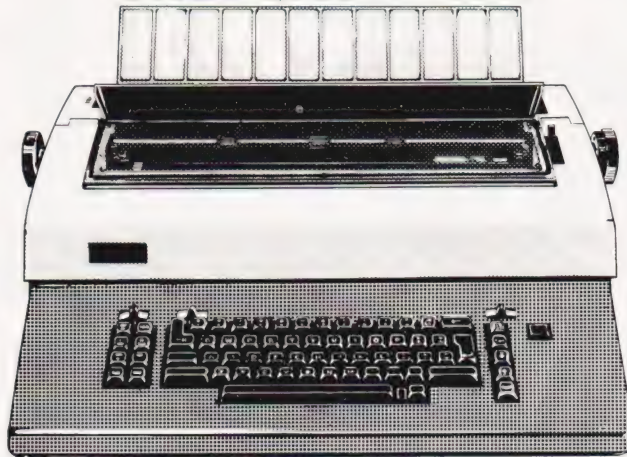
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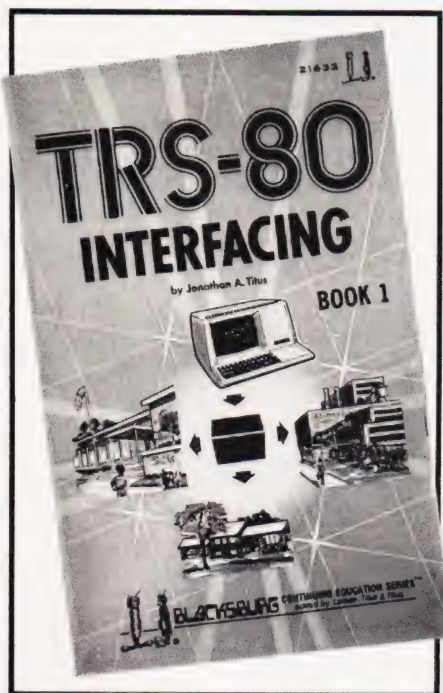
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COT 809

Adding extra peripherals to your computer often tends to be a DIY affair. We look at some books on the subject.



If you've ever connected a printer to your computer then you have been actively involved in interfacing! Loosely speaking interfacing is the name given to the task of connecting any piece of peripheral equipment to a computer. The sort of problems that crop up can be as simple as ordering the correct sort of cable for a VDU or as complex as designing a special printed circuit board. The subject is a difficult one to pin down because the solution usually requires a knowledge of electronics, of software and of the particular computer involved. Books that claim to tell you about interfacing fall into two groups. The first group is aimed at owners of particular personal computers and the second is aimed at the systems designer and is much more concerned with chips than with particular computers. Both groups assume a degree of knowledge of electronics — and sometimes even a degree *in* electronics!

If you are interested in interfacing a variety of gadgets to your computer there is no avoiding the fact that you have to know *something* about electronics. If electronics isn't your best subject you needn't despair. There are two main sorts of electronics — analogue; used to design radios and Hi-Fi etc, and digital; used to design computers, which in most people's opinion is the

easier. So, before you buy any books about interfacing, read something on digital electronics. It may not sound as if it is directly concerned with your interest in computers — but it is!

My first selection is, in fact, two books — **TRS-80 Interfacing Books 1 and 2**. These two volumes will, of course, mainly be of interest to TRS-80 owners but these are not a rare species! Book 1 starts out with a discussion of the Z80 and how 74-series TTL chips can be used to provide the standard functions used in 'low level' interfacing; eg address decoding and data latching. This part of the book is of would be useful to anyone interested in interfacing at the chip level. However the book quickly moves on into TRS-80 specific things in Chapter Five where a design for a good 'bread-board' (a general interface that can be used for experimentation) is described in detail. If you want to make use of the rest of the book it is a good idea to construct this bread-board because it is used in all the experiments that bring Book 1 to a close. The experiments are all of the 'flashing light' variety in that they do not concern connecting the TRS-80 to anything real; ie a washing machine or the proverbial central heating system. This should not be taken as a criticism, however, because there is no way of avoiding this stage of learning to interface — especially in a book. Moving on to real interfacing problems comes *after* you have destroyed a few LEDs!

Book 2 takes us into a different range of topics altogether. The first chapter starts by describing driver circuits suitable for use with any machine. It is easy to bring a piece of wire out of the back of your computer and make it change from 0 to 5 volts under program control. The problem is to then make it switch a high voltage light bulb on and off! This is where driver circuits come in to convert the low power computer signals into something large enough to affect the 'real' world. Chapter One is a good collection of basic circuits and it could serve as an excellent 'cookbook'. Chapter Two covers the inevitable A to D and D to A circuits but, along with Chapter Three, goes beyond most 'how to build a DAC' type introductions. Chapter Four brings us back to the

world of electronics with a detailed look at UARTs. A UART is a Universal Asynchronous Receiver/Transmitter and is one of the most useful (and little understood chips) around. Its basic function is to take data from parallel ports and convert it to serial data of the type that VDUs etc, need — and vice versa. The final chapter ventures into the most difficult interfacing terrain of all — interrupts. Here hardware and software meet in such a way that most people avoid the use of interrupts like the plague. Although only Z80 interrupts are dealt with, this practical approach should ease you into the area with as little pain as possible!

Both of these volumes are highly recommended reading for anyone with a TRS-80 and an interest in electronics or a master project in mind. If you haven't got a TRS-80 then they are still worth a look for their clear explanations of digital electronics applied to interfacing.

Apple Interfacing is written by the same team of authors and is mainly a 'translation' of the material in the first TRS-80 volume. Because of this it uses the same breadboard design and constructs a general interface. As the Apple has eight special interface slots this method does not make best use of its possibilities. However, the experiments and projects are interesting and would serve to teach anyone with an Apple a great deal about general interfacing. My biggest criticism of this book is that only in the final chapter are the unique features of the Apple's interfacing ports actually tackled and even here the authors duck the issue. If what you want are details of how to use the Apple's interfacing slots with chips such as the 6821 PIA or the 6850 ACIA or if you want to know how to build video cards, printer interfaces or RAM expansion cards, then you will be disappointed by this book.

There is interfacing in general and there is PET interfacing! The Commodore PET presents a very different range of problems and possibilities when it comes to interfacing it to external equipment. **PET Interfacing** covers the hardware and software details of the three input/output ports — the user port, the memory expansion port and the IEEE-488 instrumentation port. It

BOOK PAGE

provides constructional details of breadboards for both the user port and the memory expansion port and gives examples of interfacing experiments using them. The IEEE-488 is the trickiest from the point of view of both software and hardware but this book successfully tackles the problems it presents. Because of the need to take account of the IEEE-488, all the projects included in the book are specific to the PET. No printed circuit board layouts are given — readers are expected to be able to construct straight from circuit diagrams. In the case of this book, many of the projects deal with real applications rather than being simply illustrative, the IEEE printer interface being probably the most useful. This is a very good book but it is useful only to PET owners.

Microcomputer Interfacing teaches general chip-level interfacing methods but uses the 6800/6809 family in all the examples. This is not a bad thing as the 68xx family is probably the easiest to use and most advanced range of products available today. The topics covered range from the 6809 instruction set and bus signals through the use of the 6821 PIA and 6850 ACIA to interrupts, DMA and analogue conversion methods. This book is a must for anyone using Motorola products or systems but, unless you're taking an advanced course on computer hardware, this book is otherwise

likely to be of little interest.

The first microcomputer on the market used the now familiar S100 bus. In the last few years the importance of the S100 has declined because the most popular machines in the world — PET, TRS-80, Apple — use their own 'non-standard' buses. However, the S100 now looks set for a revival due to the publication of an IEEE standard (696) defining its characteristics exactly and extending its use to a 16-bit mode of operation. It seems obvious that many old S100 systems are going to be dusted off and new 16-bit CPU (68000, Z8000, 8086) cards and software added to make some of the most powerful systems around. It is in this light that the publication of **Interfacing to S-100/IEEE 696 Microcomputers** should be seen. Starting off with a description of the S100 bus, its control lines and timing relationships the book quickly moves on to the practical matter of designing and constructing S100 interface boards. Subjects covered include memory interfacing; I/O ports; keyboards; serial ports; A to D/D to A; interrupts; and timers. There is also a discussion of the very interesting but advanced topic of 'temporary bus masters' which is a key concept for any of the multiprocessor systems that are being proposed at the moment. Although you won't find any PCB or layout diagrams for S100 projects

you should be able to construct your own boards from the diagrams given. I can recommend this book if you use an S100 system or have one lying around gathering cobwebs.

The books included this month were:

TRS-80 Interfacing Book 1, by Johnathan A Titus, (1979), 190 pages, £7.65.

TRS-80 Interfacing Book 2, by Johnathan A Titus, Christopher Titus and David G Larsen, (1980), 254 pages, £8.35.

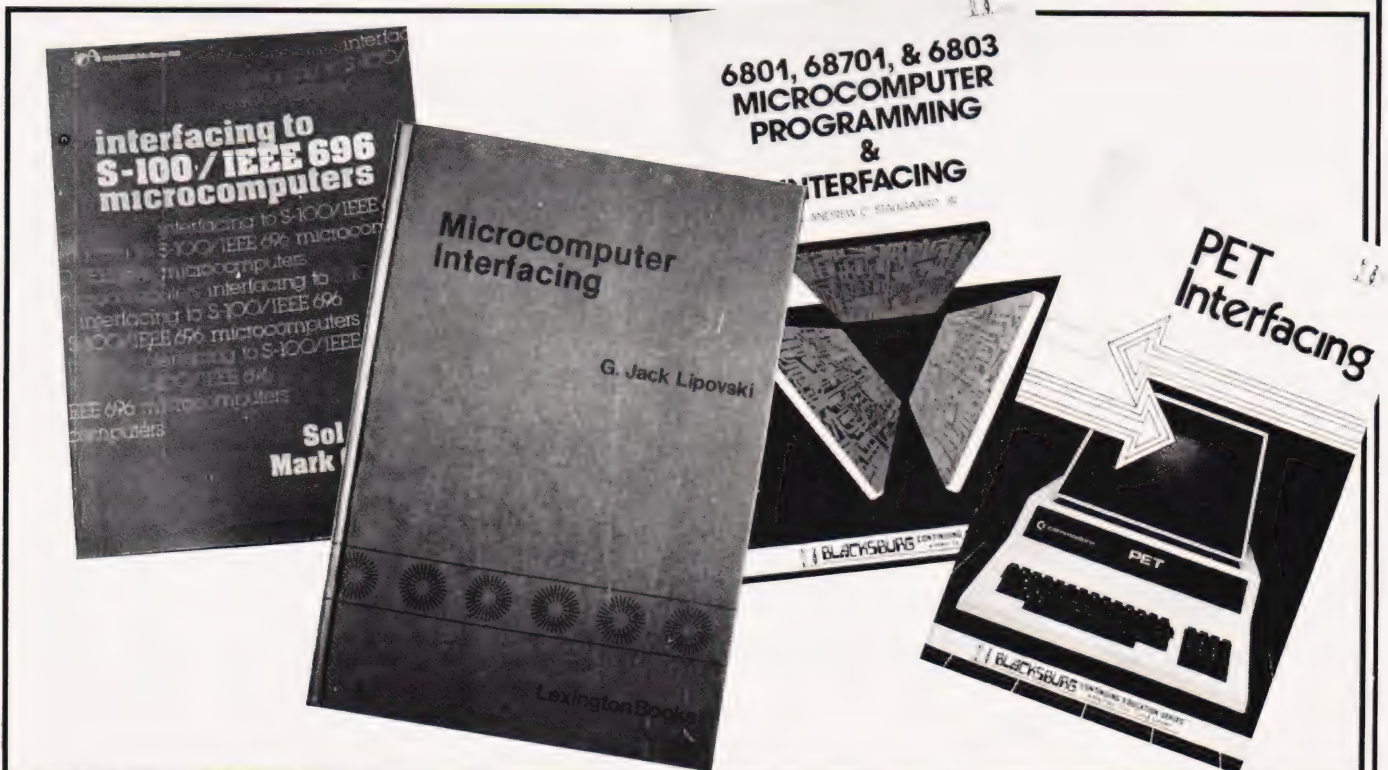
Apple Interfacing, by Johnathan A Titus, David G Larsen and Christopher Titus, (1981), 206 pages, £7.65.

PET Interfacing, by James M Downey and Steven M Rogers, (1981), 261 pages, £11.85.

These four books are all in the Blacksbury Series, published by Sams, and distributed by Computer Bookshop.

Microcomputer Interfacing, by G Jack Lipovski, published by Lexington, (1981), £15.00.

Interfacing to S100/IEEE 696 Microcomputers, by Sol Libes and Mark Garetz, published by Osborne/McGraw Hill, (1981), £10.95.



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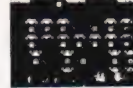


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THE ART OF DATA STORAGE

D S Peckett

We move on to look at the way numbers can be stored in blocks on tape, efficient coding packs them in.

This month we start to handle numerical data. First, I will concentrate on the various ways a computer stores numbers and then show how they are stored on tape. Finally, I will provide you with a method of making more efficient use of tape by storing more numbers on a given length of tape. As in last month's article, I will illustrate my points with suitable BASIC subroutines. These are constructed so that you can incorporate them into your own programs as and when you wish. The subroutines all assume that the data is to be read from, or written to, the array DT(), and that N items are to be handled. Other than these, the subroutines use only variables starting with Z; avoid Z-variables in your own programs and there will be no risk of corruption.

Any or all of the subroutines can be mixed together without any chance of them interfering with each other. You should also note that the routines are written to be easy to follow, not to run quickly. They can be compressed and speeded-up quite considerably once you understand how they work.

Although I will avoid machine-dependent code as far as possible, all my routines are written in Level II BASIC for a TRS-80 or Video Genie; however, with the exception of the specific commands to write to and read from tape, they should be completely compatible with other versions of Microsoft BASIC (eg PET, Apple, etc).

Number Storage

Microcomputers generally store numbers in one of two fundamental forms: integer and floating-point. Integers are used to save whole numbers (ie no decimals) between -32768 and +32767 (normally), while floating point (FP) numbers are used if decimals and/or very large or small numbers are involved. Level II, as a typical example, can handle positive and negative numbers varying in magnitude from $.0001 \times 10^{-34}$ to 1.70141×10^{38} .

Level II also has 'double-precision' numbers, which are in the same floating-point range as above but have more places after the decimal point. I won't refer to them

again - they are stored in a similar manner to ordinary FP numbers, but take up more space.

The storage of integers is fairly straightforward: each one is held in two adjacent bytes (Fig.1). This gives a total of 16 bits to store the number; only the 15 least-significant are used to give the magnitude (hence the maximum of 32767), while the most-significant bit (MSB) holds the sign. If the sign bit is 0 the number is, by convention, positive while an MSB of 1 means a negative number. In fact, there is a little more to it than that because negative numbers are normally held in a modified format called twos complement which makes arithmetic easier, but that is a detail which need not concern us here.

Floating-point numbers can be held in many ways, but the most common in micros uses four adjacent bytes in the normalised mantissa and exponent format of Fig.2. You may know that a shorthand way of writing 345298000000 is 3.45298×10^{11} . The second format, often called scientific notation, is another normalised mantissa and exponent format; the mantissa is the 3.45298 part while the exponent is the power of 10 (11 in this case). The normalised part comes in because the mantissa is generally set up to have only one digit in front of the decimal point regardless of the overall size of the number.

Floating-point storage in micros is very similar except that it uses binary arithmetic and generally has

zero in front of the binary (not decimal!) point - the mantissa is stored as a fraction. The exponent is, not surprisingly, a power of two and is stored in the first byte of the four as a seven-bit integer, with the MSB providing the exponent's sign. The three remaining bytes hold the mantissa, again using the MSB for sign (of the overall number this time) and with 23 bits available after the binary point.

As an example, how would we store 13.5 as a binary floating-point number? The first step is convert it to the mantissa/exponent form by finding the smallest power of two which is larger than the number itself - this is 16 (2^4). Dividing to give the normalised form we set:

$$13.5 = 0.84375 \times 2^4$$

We now see that the mantissa is 0.84375 and the exponent is 4; the 2 in 2^4 can be taken for granted and does not have to be specified.

Now to convert the mantissa to a binary number - how do we work out binary decimals (binarals?)? In decimal arithmetic, we know that:

$$0.abcd = (a/10 + (b/10^2) + (c/10^3) + (d/10^4))$$

Binarals are just the same:

$$0.pqrs = (p/2 + (q/2^2) + (r/2^3) + (s/2^4))$$

or:

$$0.84375 = 1/2 + 1/4 + 0/8 + 1/16 + 1/32 = 0.1101$$

In this case, we could actually hold

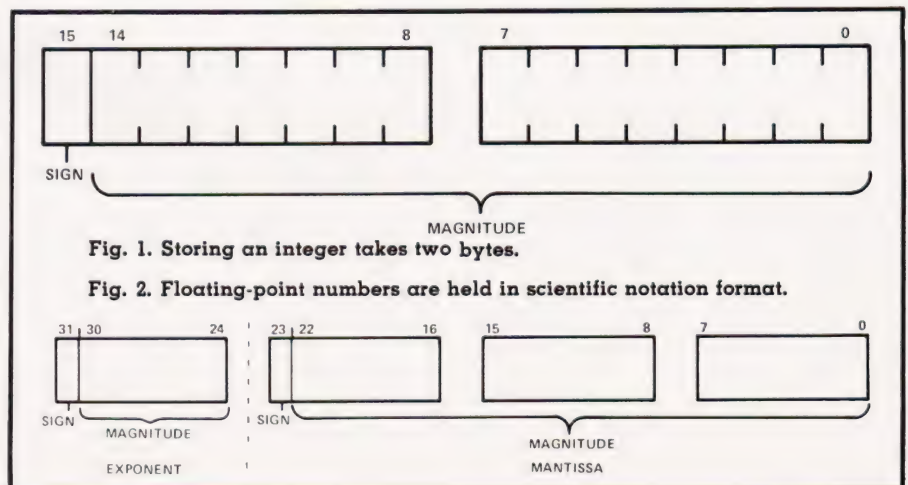




Fig. 3. How the number 13.5 is stored in floating-point form.

the mantissa in a single byte; Fig. 3 shows 13.5 stored as an FP binary number. The third and fourth bytes are, of course, equal to zero.

Just to make life interesting, Level II actually stores the four bytes in the opposite order to the one I have just described. However, this does not, surprisingly, affect the routines I will be giving you.

Conventional Number Storage

Suppose you write the command "PRINT# -1,A" to save the variable A to tape. The computer does not, as you might expect, save the two or four bytes holding A on the tape. Instead, it writes a string representation of the decimal value in A to the tape. It actually does a PRINT# -1,STR\$(A).

For example, suppose that A is a floating-point variable containing the value -2.38904E-23; those 12 ASCII characters, including the minus signs, decimal point and exponent sign would all go to tape. If, on the other hand, A was set to zero, 0 would go to tape first - notice that a leading space is written to show that the number is non-negative.

The main snags with saving numbers on tape via the computer's built-in routines are:

- a. Each number is stored as a string of unpredictable length, making it difficult to pack the tape fully and to recover the data.
- b. Much space can be wasted - up to 12 characters are needed to define a number which is actually held in only four bytes.

We can, however, still make good use of tape by means of suitable subroutines. We will aim to pack as many numbers into a given tape block while still retaining the string-based storage. By stripping off the leading blanks - if there is no minus sign the plus is implicit - we can squeeze the maximum number of values into each tape block, packing them into the single dummy strings forming each block.

Because this approach leaves each value as a string of undefined length, we must also add a separator (eg a !) between each number in the

dummy string. Then, when we recover the data, we can scan the input string character-by-character, treating the characters between each separator as forming a variable and assigning its value to the appropriate place.

Although this approach makes the best possible use of tape, assuming that we are storing numbers in their string format, it is very slow at reading the data back. Reading and checking each individual character is very laborious. A much faster, though slightly more wasteful of tape, approach is to convert each number to a string of fixed length. Take a look at Listing 1, which is a development of the routine I gave last month for storing strings of fixed length.

Initially Z1 is set to the maximum length of the string version of a variable: integers can be up to six characters long, including sign, while floating-point numbers are represented in Level II by strings of up to 12 characters long. The key part of the routine is lines 10060 and 10070. These read each value to be saved and convert it to a string which is extended by a suitable number of spaces to guarantee that it is longer than the maximum length of the number alone. This extended version of the number string is then truncated to the standard length and added to the dummy string which will be written to tape.

The rest of the subroutine is concerned simply with the basic housekeeping of saving the correct number of values and filling up ZA\$ as much as possible before writing it to tape.

Listing 2 is a routine, again derived from the procedures I gave last month, to read back the data saved by Listing 1. From the point of view of recovering the numeric data, the key lines are 11070 and 11080; the rest are once again there for housekeeping.

Line 11070 uses the MID\$() function to recover the padded string representing the next number from the dummy string ZA\$. Once recovered, the VAL() function converts it back to a numeric value

which can be saved in DT(). A word of possible warning here: in Level II BASIC, VAL() ignores the trailing spaces used to pad out the number string - I cannot guarantee that all other computers will react the same way. If they are confused by the spaces, you will not be able to use this approach.

As a measure of the performance, these routines can save 500 integers to tape in 118 seconds and recover them in 132 seconds. The corresponding times for floating-point numbers are 220 seconds and 236 seconds respectively. Virtually all the extra time for FP numbers comes from the fact that twice as many data blocks must be written and read.

Byte-Oriented Storage

These procedures are simple to write and understand, but they are rather wasteful of tape space. They need six bytes to store each integer and 12 for each FP number when these variables are actually stored in only two and four bytes respectively. Surely there must be a way of just writing the binary version of the numbers to tape?

There is, of course - otherwise I would not have mentioned it! Things are not, however, quite as simple as they might be. Although we could take each byte of a number, convert it to a character (via CHR\$()) and write it to tape, we must be careful not to confuse the computer. If you read last month's article (if not, send off for a backnumber now), you will recall that, in Level II BASIC, and probably in other dialects, some characters do funny things to the tape input procedures.

In particular, commas (,), colons (:) and quotes (") are symbols which control the reading of input data. If they appear in the wrong places, the program will almost certainly crash. However, since the variables can have any value, any of the bytes of data making them up could quite easily have the same numeric value as the ASCII codes of any or all of the symbols above. We cannot, therefore, use these bytes directly.

The simplest way out of this problem is to take a maximum of seven bits, out of the 16 holding an integer or the 32 holding an FP number, at a time. Treat these seven as the LSBs of a byte and set the MSB to one (Fig. 4). This will give the byte a value between 128 (if all seven are 0) and 255 (if all seven are 1). This new value can be

THE ART OF DATA STORAGE

converted to a character without any fear of crashing the input procedure since it is larger than any of the control characters.

Bytewise Integer Storage

Integers are relatively easy — as long as you are prepared to be cunning. Most computers have the AND operator which can be used to do a bit-by-bit comparison of two integers providing a third integer whose value is given by the bits set to 1 in the two compared values. Fig. 5 shows what happens when we compute (1295 AND 1003). Only bit 8 is set in both numbers so the answer is 256, the decimal representation of the bottom line of Fig. 5.

The significance of this operator is that we can use it to isolate any combination of bits we may wish (except the MSB, or sign, bit). For instance, to acquire bits 8-14 of variable A we could use:

```
(A AND 32512)
```

The answer is another integer with bits 0-7 and 15 set to zero, and with bits 8-14 identical to those in A.

Now, we want to use this approach to create single bytes which we can then use CHR\$() on. How do we get bits 8-14 into bits 0-7 if they must be in the lower byte for CHR\$() is to work? Look at the following:

```
(A AND 32512)/256
```

and simply divide by 256 to shift the whole thing eight bits to the right.

Finally, we have to set bit 7 making the value into a character:

```
CHR$((A AND 32512)/256+128)
```

Just add 128! The result is a pseudo-character containing bits 8-14 of the original variable A.

Obviously, you can use this approach to read any group of bits in an integer. But beware - the trick does not work on FP numbers and we have to resort to more devious methods, as I will explain next month.

Having gone through all that, take a look at Listing 3 which shows a subroutine for storing integers in three-character groups. Once again, it has evolved from the routines for storing fixed-length strings. Each dummy string can hold 83 (ie 249/3) coded integers.

The key lines in the routine are 12050-12110. Line 12050 sets the appropriate variable into a dummy variable to make it easier to handle

```

9999 REM ** SAVE A SERIES OF NUMBERS AS STRINGS
10000 Z1=[q]:REM ** q=6 FOR INTEGER, 12 FOR FP
10010 Z2=INT(249/Z1):REM ** NUMBER OF ITEMS PER BLOCK
10020 FOR Z3=1 TO N STEP Z2
10030 ZA$="":REM ** CLEAR DUMMY STRING
10040 IF (N-Z3)>Z2 THEN Z4=Z2-1 ELSE Z4=N-Z3
10050 FOR Z5=Z3 TO Z3+Z4:REM ** LOOP MAXIMUM NO OF TIMES
10060 ZN$=STR$(DT(Z5)+STRING$(Z1,"[SPC]"):REM ** PAD IT
10070 ZA$=ZA$+LEFT$(ZN$,Z1):REM ** ADD TO DUMMY STRING
10080 NEXT Z5
10090 PRINT#-1,ZA$:REM ** SAVE IT
10100 NEXT Z3:REM ** BACK FOR MORE
10110 RETURN:REM ** DONE
    
```

Listing 1.

```

10999 REM ** RECOVER FIXED LENGTH STRINGS
11000 Z1=[q]:REM ** q=6 FOR INTEGER, 12 FOR FP
11010 Z2=INT(249/Z1):REM ** NUMBER OF ITEMS PER BLOCK
11020 Z3=INT(N/Z2+0.9999):REM ** NUMBER OF BLOCKS
11030 FOR Z4=0 TO Z3-1:REM ** PROCESS EACH BLOCK
11040 INPUT#-1,ZA$:REM ** GET IT
11050 Z5=LEN(ZA$)/Z1:REM ** HOW MANY ITEMS IN BLOCK ?
11060 FOR Z6=1 TO Z5:REM ** READ EACH ONE
11070 ZN$=MID$(ZA$, (Z6-1)*Z1+1,Z1):REM ** NUMBER STRING
11080 DT(Z4*Z2+Z6)=VAL(ZN$):REM ** CONVERT TO A NUMBER
11090 NEXT Z6
11100 NEXT Z4:REM ** BACK FOR MORE
11110 RETURN:REM ** DONE
    
```

Listing 2.

```

11999 REM ** SAVE INTEGERS IN BINARY FORMAT
12000 Z1=83:REM ** NUMBER WE CAN SAVE PER BLOCK
12010 FOR Z2=1 TO N STEP Z1
12020 ZA$="":REM ** CLEAR DUMMY STRING
12029 REM ** MAKE SURE THERE ARE ENOUGH ITEMS TO FILL
12030 IF (N-Z2)>Z1 THEN Z3=Z1-1 ELSE Z3=N-Z2
12040 FOR Z4=Z2 TO Z2+Z3:REM ** LOOP THROUGH
12050 ZQ=DT(Z4):REM ** GET VARIABLE
12060 ZF=(ZQ<0):REM ** SET ZF IF ZQ NEGATIVE
12070 IF ZF THEN ZQ=-ZQ:REM ** FORCE ZQ POSITIVE
12080 ZX$=CHR$((ZQ AND 32512)/256+128):REM ** GET 7 MSBs
12090 ZY$=CHR$((ZQ AND 240)/16+128):REM ** GET BITS 4-7
12100 ZZ$=CHR$((ZQ AND 15)+128-(ZF*64)):REM ** LSBs
    AND SIGN
12110 ZA$=ZA$+ZX$+ZY$+ZZ$:REM ** SAVE IN DUMMY STRING
12120 NEXT Z4
12130 PRINT#-1,ZA$:REM ** SAVE IT
12140 NEXT Z2:REM ** BACK FOR MORE
12150 RETURN
    
```

Listing 3.

```

12999 REM ** UNPACK CODED INTEGERS
13000 Z1=83:REM ** NUMBER OF VARIABLES PER BLOCK
13010 Z2=INT(N/Z1+0.9999):REM ** NUMBER OF BLOCKS TO READ
13020 FOR Z3=0 TO Z2-1:REM ** LOOP Z2 TIMES
13030 INPUT#-1,ZA$:REM ** READ A BLOCK
13040 Z4=LEN(ZA$)/3:REM ** NUMBER OF ITEMS IN THIS BLOCK
13050 FOR Z5=1 TO Z4
13060 ZD$=MID$(ZA$, (Z5-1)*3+1,3):REM ** GET A CODED
    NUMBER
13070 ZQ=(ASC(LEFT$(ZD$,1)) AND 127)*256:REM ** 7 MSBs
13080 ZQ=ZQ+(ASC(MID$(ZD$,2,1)) AND 15)*16:
    REM ** BITS 4-7
13090 ZQ=ZQ+(ASC(RIGHT$(ZD$,1)) AND 15):REM ** LSBs
13100 IF (ASC(RIGHT$(ZD$,1)) AND 64) THEN ZQ=-ZQ:
    REM ** SIGN
13110 DT(Z3*Z1+Z5)=ZQ:REM ** SAVE THE ANSWER
13120 NEXT Z5
13130 NEXT Z3
13140 RETURN
    
```

Listing 4.

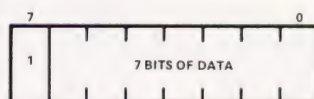


Fig. 4. Taking a byte out of the number allows it to be represented as a character.

```

0000 0101 0000 1111 (1295)
AND 0000 0011 1111 0000 (1008)
-----
0000 0001 0000 0000 (256)
    
```

Fig. 5. Masking an integer with the AND operator.

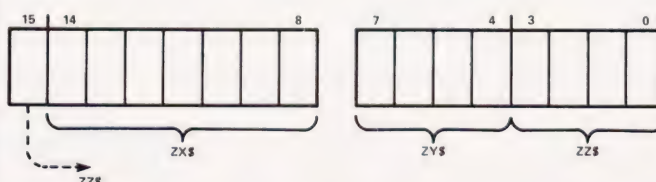


Fig. 6. The number reduced to strings (see Listing 3).

THE ART OF DATA STORAGE

— it is much quicker to retrieve ZQ than DT(n). In line 12060, ZF is set as a flag to show that the variable is negative and, if it is, line 12070 forces ZQ to be positive. This subterfuge is necessary because the AND technique does not work on negative numbers; to test your understanding, see if you can work out why - answers, in less than 2000 words, to the Editor! **(On the backs of clean 100\$ bills please. Ed!)**

Having converted ZQ to a form we can handle, lines 12080-12100 form the three pseudo-characters holding the number. The 15 significant bits of the number are split into one group of seven, and two of four (Fig.6). Line 12100 also sets bit 6 of ZZ\$ to show the sign of the original number; it relies on the fact that Level II stores TRUE flags as the value -1 and NOT TRUE flags as 0. -(ZF*64) thus has the value +64 if ZF was set and 0 if it was not.

Note here that other BASICs may represent TRUE as +1, in which case the - sign should be a +. To find out what your system does, type PRINT (1=1) - you should see -1 or 1 as appropriate.

Incidentally, and notwithstanding the way in which flags are set, most BASICs will treat any non-zero number as TRUE.

Having formed the three pseudo-characters, they are now simply added to the dummy string ZA\$ and is written to tape as and when appropriate.

Listing 4 shows how we can get the numbers back again. Line 13060 extracts the three bytes holding the number, and the number itself is formed by lines 13070-13110.

The AND trick is used to separate the needed bits out of each character and they are shifted left n bits by the *2. The number is assembled in the dummy variable ZQ forming a positive integer. Line 13100 tests bit 6 of the original ZZ\$, which contains the sign of the number; having made the test, it uses the non-zero is TRUE property to control the sign of ZQ. Finally, line 13110 assigns the value in ZQ to the correct location in DT().

This is a much more complicated way of doing things than simply saving numbers as strings. Is it worth it? Certainly, it obviously only uses half as much

tape - numbers are held in three bytes as opposed to six - and it runs faster. 500 random integers are saved in 108 seconds and recovered in 102 seconds. That is an 8.5% improvement in write time and a 22.7% improvement in data recovery time; the overall improvement in the read/write cycle is 16%.

Conclusion

There you have an introduction to the storage of numbers in a computer. As you see, several different formats are used and you must understand each one if you are to make the best use of tape. This month I have given you general-purpose routines for saving any number to tape, and more efficient routines designed to handle integers.

Next month we will go on to see how we can exploit our knowledge of floating-point number storage to make a 20% improvement in read/write cycle time for storing such variables. I will also describe a way of improving still further integer storage time in special, but common, circumstances.

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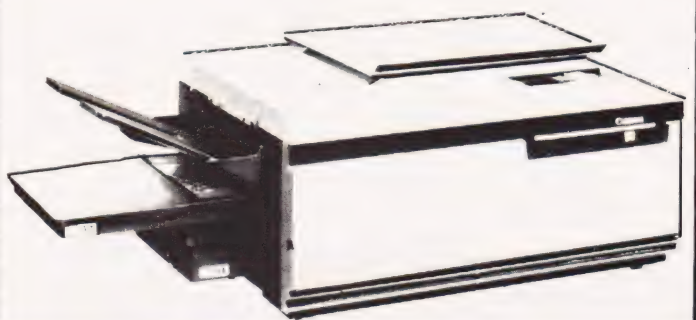
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TAPE INDEXER

Keeping track of your programs.

There are two ways to store program files on cassettes: 1) one file per cassette, and 2) sequentially filling one cassette before starting another.

However, if you choose the first option, you quickly run out of money and storage space. With the second you will probably, as I do, run out of patience with the long searches and haphazard Fast Forwards (FFWD) and Rewinds. Hence this program, which reduces the search time by a factor of between 10 and 20 depending on the file's position on the tape, should prove very useful.

The program works by:

- Storing the FFWD times needed to reach each file.
- Using the FFWD button to start the PET's internal clock
- Linking the relevant FFWD time to the file being called, then using it to indicate on the screen when the tape stop button must be pressed.

Program Description

The ingenious program by Trevor Lusty in CT, December 1980, forms the basis for my program. The clever bits on lines 54 to 60 are his and remain intact providing, as in the original, automatic loading of the file selected on line 46.

Lines 78 to 82 have adapted the 'Lusty technique' to position the tape to accept a SAVE. The program does this by identifying (on lines 70 to 74) the last file on the tape, then verifying it instead of loading it, thereby leaving the program in the PET's memory intact. The selection of LOAD or position-to-SAVE is made on lines 24 to 28.

The subroutine starting at line 200 uses the PET's TI function as a countdown clock (à la Cape Canaveral) and, by holding the program on line 230, delays the start of the countdown until FFWD is pressed. Line 290 then stops the clock when it reaches zero, or when the tape-stop button is pressed... whichever comes first. However, if the clock reaches zero with the tape drive still in FFWD, the operator is given a 'Stop The Tape' message on the screen, followed by a short period in which to react before the

program reaches the point of no return!

If the operator succeeds in pressing the tape stop button before egg-on-the-face time, the program returns to line 54 or 78 and automatically prints a LOAD or VERIFY statement, depending on which was selected. This is followed by the normal 'PRESS PLAY AND RECORD' message.

The Verify Files

Only the last VERIFY file is ever used, so there is no need to remake existing libraries with interleaved 'real' and 'verify' files. By the same token, only the last VERIFY file need be listed in the index (lines 500 to 510).

They do require numbering, however, otherwise there is the possibility that the PET's search routine will find the wrong one, verify it, stop the tape at the beginning of a 'real' file and then quietly erase it while saving the program in its memory! For example, to add a new file to the sample index shown, proceed as follows:

A) change line number 505 to 506 and the file name to 'VERIFY 2' and then,

B) create a new line 505 with the new file name in the same format as the others.

All that is needed for a verify

program is: 10 REM VERIFY N

FFWD Times

The writer managed to evolve a sure and simple method of determining the FFWD times — unfortunately a blow by blow description threatened to double the length of this article so it never got beyond a rough draft. In any case, common sense and some trial and error are the only requirements, so CT readers should have no problems!

The times are stored in line 510 and READ by line 22. The first two DATA constants are zero because, of course, you can't FFWD to the 'FILE INDEX' file itself or to the first 'real' file, in this case, Othello. The third DATA constant is nine because it takes nine seconds to FFWD from the end of 'FILE INDEX' (this program) to a point just before the end of Othello. The clock thus starts its countdown at nine when you ask the program to load Blackjack, at 23 when you ask for Backgammon, and so on...

This isn't a very elegant program, it might even be considered downright messy! However, apart from my 'work in progress' tapes, I now have just two cassettes: one for games and one for utilities.

Most of All...

The program pays real dividends in vastly shortened search times. Just think... a program embedded in the middle of a C60, and yet the search-and-find time is less than 100 seconds. Bliss, perfect bliss!



Program Listing

```

2 REM ** ACKNOWLEDGEMENTS TO TREVOR LUSTY
4 REM ** OCCUPIES 1.839K WHEN LOADED
6 REM ** RUNS IN 1.989K. CURSOR CONTROLS ON
8 REM ** LINES 54,58,78 AND 200 ARE ESSENTIAL
10 REM ** RESP ARE WINDOW DRESSING
12 REM ** NEW ROM PETS ONLY AS SHOWN
20 FOR A=0 TO 9:READ AS(A):NEXT A
22 FOR A=0 TO 9:READ T(A):NEXT A
24 PRINT "[CLS][4 CD][3 SPC]DO YOU WISH TO:-"
26 PRINT TAB(4)"[CD][REV][SPC]1[SPC][OFF][2 SPC]TO
LOAD AN EXISTING PROGRAM?"
28 PRINT TAB(4)"[CD][REV][SPC]2[SPC][OFF][2 SPC]TO
POSITION THE TAPE TO SAVE [15 SPC]A NEW ONE?"
30 GET AS:IF AS="" THEN 30
32 IF VAL(AS)<1 OR VAL(AS)>2 THEN 30
34 ON VAL(AS) GOTO 40,70
40 PRINT "[CLS][CD]FILES ON THIS TAPE ARE:-[CD]"
42 FOR A=0 TO 9:PRINT TAB(5)"[REV]";A;"[CL][SPC][OFF]
[2 SPC]";AS(A):NEXT A
44 PRINT TAB(9)"[3 CD]WHICH FILE DO YOU WANT?"
46 GET BS:IF BS="" THEN 46
48 F=VAL(BS)
50 IF F=0 THEN 46
52 IF F>1 THEN GOSUB 200
54 PRINT "[CLS][3 CD]LOAD";CHR$(34);AS(F);CHR$(34)
56 POKE 158,5:POKE 623,13
58 POKE 624,82:POKE 625,85:POKE 626,78:POKE 627,13:
PRINT "[ROM]"
60 END
70 FOR V=9 TO 1 STEP-1
72 IF RIGHTS(AS(V),3)<>"USE" THEN 76
74 NEXT V
76 F=V:GOSUB 200
78 PRINT "[CLS][3 CD]VERIFY";CHR$(34);AS(V);CHR$(34);
"[ROM]"
80 POKE 158,1:POKE 623,13
82 END
200 PRINT "[CLS][3 CD][4 SPC]IF CASSETTE IS IN PLAY
MODE"
210 PRINT "[CD][4 SPC]PRESS THE STOP BUTTON"
220 PRINT "[2 CD][4 CPC]THEN HIT ANY KEY TO CONTINUE"
230 GET AS:IF AS="" THEN 230
240 PRINT "[CLS][4 CD][3 SPC]PRESS FFWD, THEN STOP WHEN
COUNTER"
241 PRINT TAB(3)"[CD]REACHES ZERO..."
250 IF (PEEK(59411) AND 56)=55 THEN 250
260 TIS="000000"
270 T=T(F)-INT(TI/60)
280 PRINT TAB(18);"[CLS][REV]";T;"[CL][SPC]"
290 IF T=0 OR PEEK(59411)=61 THEN 310
300 GOTO 270
310 PRINT TAB(10);"[CD][REV]STOP CASSETTE DRIVE!![OFF]"
320 FOR X=1 TO 150
330 IF PEEK(59411)=61 THEN RETURN
340 NEXT X
350 PRINT "[6 SPC][CD][REV][4 SPC]TOO LATE! YOU MISSED
IT![4 SPC]"
400 GOTO 400
500 DATA "FILE INDEX"
501 DATA "OTHELLO":REM.....
502 DATA "BLACKJACK":REM.....
503 DATA "BACKGAMMON":REM.....
504 DATA "MAZE":REM.....
505 DATA "VERIFY 1":REM.....
506 DATA "FILE 6.....NOT IN USE"
507 DATA "FILE 7.....NOT IN USE"
508 DATA "FILE 8.....NOT IN USE"
509 DATA "FILE 9.....NOT IN USE"
510 DATA 0,0,9,23,34,36,00,00,00,00

```



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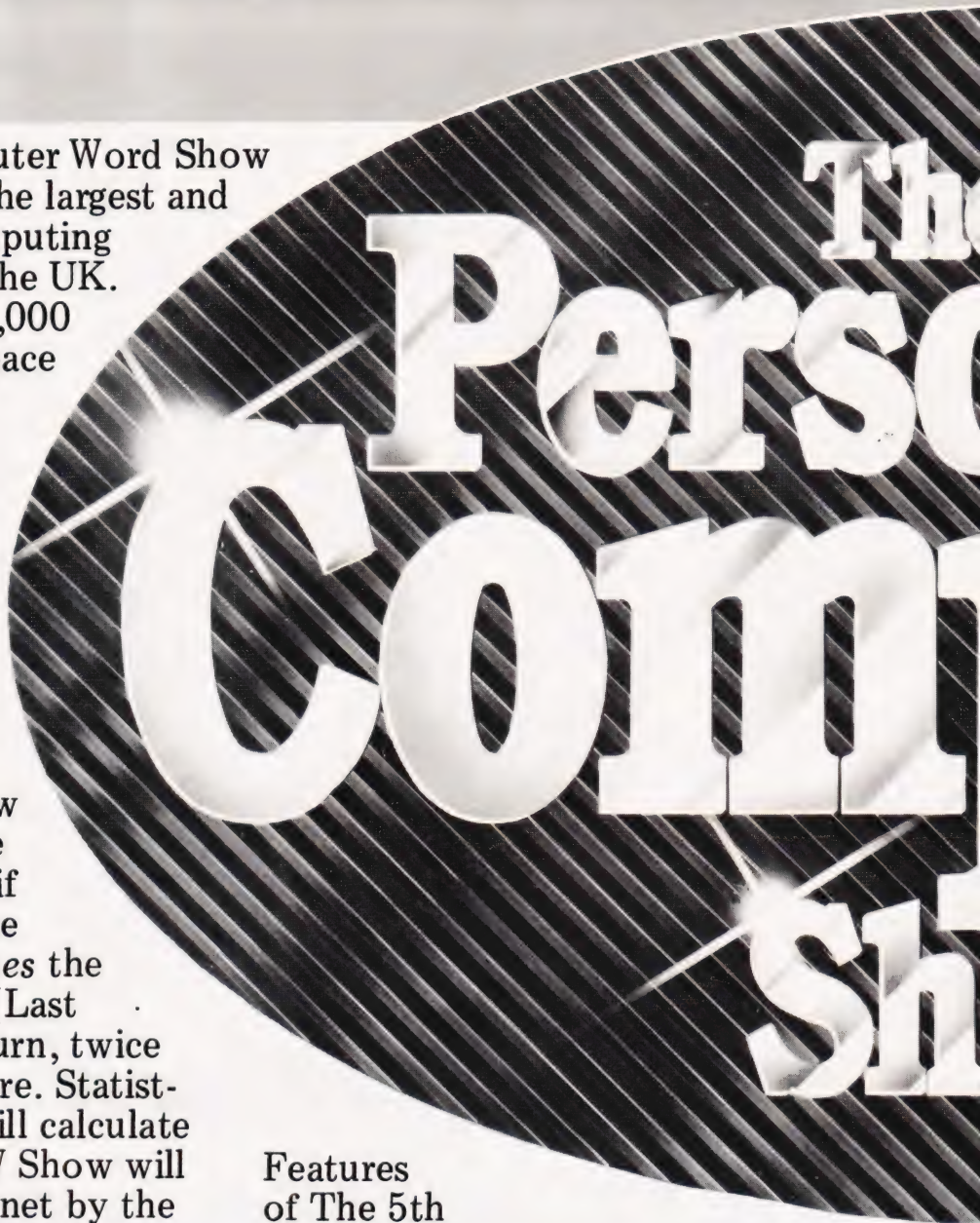
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Dear Sir,

Having owned a BBC Model A Micro since mid March, I have had great fun in exploring deeper into the machine's commands than the Provisional Manual cared to go. In doing this many new and powerful commands have come to light. So far I have found a way of turning off the cursor, disabling the keyboard except for the Break key and setting the Caps and Shift locks in software.

Apart from VDU 23 defining the character set it is also possible to re-define the flashing text and graphics cursors as well as turn them off. For example:

VDU 23;&200A;0;0;0;

turns the cursor off whereas:

VDU 23;&720A;0;0;0;

turns it back on.

This is obviously useful in games as it prevents the cursor flashing around the screen. Other values of the VDU 23 command around the two shown above will re-define the cursor although some numbers upset the screen.

Keyboard input can be located by ?215 but it is not ASCII coded and can, therefore, be used to pick up the Shift and Caps Lock keys. POKEing the next location (216) allows you to alter the state of either of these keys from your programs. The locations 217 and 218 are the repeat delay and repeat rate and, once again, they can also be altered under software control. The entire keyboard can be disabled by POKEing a 0 to location 215 although the Break key is not affected.

The list goes on and on but it might spoil the fun if too much was given away. If anyone knows how to disable the Break key or change the border colour from black I would like to hear.

Yours faithfully,
Ian Hutt
Hampton

(*Mr Hutt's letter carried on (and on, and on) so I've edited some of the more commonly known points he raised. The answer to the Break key is to re-program it under the *KEY command, it's KEY 10, by making it 'OLD and RUN' the program it's just 'broken'. The new manual thudded onto my desk today and once I've recovered

from the shock I'll be attempting to read through it, War and Peace looks like a VIC manual compared to this! Ed. *)

Dear Sir,

In April I ordered a ZX Spectrum at the Micro Fair where it was launched and was promised delivery within 28 days. Every magazine I see quotes two weeks delivery, which I think is incredibly optimistic. I still have not got my computer and when I phoned Sinclair's Customer Service I was told that there was a technical hitch and all units had been sent back to the manufacturer.

Why cannot firms wait until they have ironed out all the operational bugs before they offer them for sale and guarantee delivery within a specified time?

Yours faithfully,
M Bywater
Stevenage

(* This letter reflects the tone of many we receive on the subject of delayed delivery. The problems with the ZX Spectrum should have now all been overcome and you should have received your system. If the world was perfect then everything would be available off the shelf but, as we know, this seldom if ever happens! Ed. *)

Dear Sir,

In general, the mathematical complexities of The Valley seem not unreasonable, though not when you have just been killed off by a Balrog or Thunder Lizard, perhaps. However, I feel there is one calculation which is out of line.

In 3620 you have;

$$E = 39 * \text{LOG}(EX) / 3.14$$

Microsoft BASIC calculates the log of EX, multiplies it by 39, and divides the result by 3.14. Now, if this were the intention, there would be no point in both multiplying and dividing. Multiplication by 39/3.14 or 12.4 would suffice. On the other hand, the intention might have been;

$$E = 39 * \text{LOG}(EX / 3.14)$$

Now, E is used to increase the damage done to monsters as one's experience grows, the damage

done by the monster also being reduced. As the calculation of E stands, it will range in value from 20 to about 150, producing a change in basic damage of 0.2 to 1.5, which is scarcely significant. The alternative suggested above produces a range from 0.2 to 430, a swing of 4.1 damage points. That seems more reasonable, making experience have a real effect on combat.

Yours faithfully
Don Thomasson
Harrow

(* The values given in the program as published are correct and as intended. The formulae derives from one used in wargaming and is, apparently, well proven. However, what is not proven is the adaptability of these standard formulae to the more direct combat situations of an adventure game. Perhaps if other people have comments along these lines we could establish a new set of formulae for this type of program. Ed. *)

Dear Sir,

After having a brief look at your article on REFLECTIONS in the May 1982 issue of Computing Today, I decided that I would write a shorter program to use the same idea in a different way. The result is shown below.

I call it FLOWER for want of a better name because, as the program progresses, the picture evolved is not unlike a blooming flower.

Lines 10-30 set up a small machine code routine to handle any errors that the program comes across. Although most of the Illegal Quantity errors are handled at 90 & 100, the program tended to stall without the use of the machine code routine which the Apple II manual supplies to clear up these problems.

Being a lazy programmer, to allow the user to stop the program and either finish or save the picture formed, I used the same error routine that stops it stalling. The user can stop the program by using the same CTRL-C which stops most programs, but then they have a choice. By pressing one of four keys:

F... This finishes and halts the program completely
C... Continue

*R...Run again
S...Allows the user to save the
picture on disk.*

```

10 FOR I=768 TO 777:READ A:POKE I,A:NEXT I
20 DATA 104,168,104,166,223,154,72,152,72,96
30 ONERR GOTO 210
40 TEXT:HOME:PRINT:PRINT "SUSTAIN="::INPUT U
50 HGR:POKE-16302,C
60 X=139:Y=95:H=X:V=Y
70 GOSUB 160:HCOLGR=F
80 FOR I=1 TO U
90 IF H+D>279 OR H+D<0 THEN 70
100 IF V+E>191 OR V+E<0 THEN 70
110 H=H+D:V=V+E
120 A=H-X:E=V-Y
130 HPLOT H,V TO (X-A),(Y-B)
140 HPLOT (X-A),V TO H,(Y-B)
150 NEXT I:GOTO 70
160 D=INT(RND(1)*3)
170 E=INT(RND(1)*3)
180 F=INT(RND(1)*2)
190 L=L-1:D=D-1
200 RETURN
210 REM ** ERRORS ETC
220 CALL 768
230 IF PEEK(222)<>255 THEN 60
235 REM ** 255=CTRL C
240 GET AS
250 IF AS="F" THEN END
260 IF AS="S" THEN 300
270 IF AS="B" THEN RUN
280 IF AS="C" THEN RESUME
290 GOTO 740
300 POKE-16301,0:VTAB 22
310 PRINT "SAVE AS":INPUT AS
320 PRINT CHR$(4)"BSAVE "AS":.AS2000.LS2000"
330 POKE-16302,0:GOTO 240

```

*Yours faithfully,
PA Elliott
Cirencester*

Dear Sir,

In your June issue you published a letter from Mr B Carroll stating that the BNC connector on the BBC Micro does not provide a colour signal. This can be remedied by carefully soldering a 470 pF capacitor between the emitter of Q9 and the base of Q7.

On the subject of TV/monitors that are starting to appear on the market are there any that you would recommend for use with a home computer?

*Yours faithfully,
A Jones*

(address not supplied)

(* Firstly, my thanks to Mr Jones and Mr I M Williams who answered the question about the BBC Micro. Sadly, Mr Williams's letter was too long to publish but we hope to use the information he supplied in a later feature on the BBC Micro.

With regard to monitors, I assume you mean for the BBC Micro, I would wholeheartedly recommend the NEC Character Display monitor (for monochrome work) and the Microvitec range of LCCD colour monitors. Both these will work with a wide range of machines but the latter needs the system to be specified as there are a number of variants. They are not cheap, £125 for the former and

£290 for the latter, but worth it in terms of the quality. Prices may change so the above should be taken as a guideline only. Ed. *)

Dear Sir,

There appears to be an error in Douglas Rice's keyboard scan routine published in the July Printout. It should read POKE 4158,223.

There also seems to be a few details missing from my Display Planner, also featured in the same issue. The most important is that the BASIC routine does not always print the decimal equivalent. Instead it will output some numbers (which may be the decimal equivalent) underneath the Hex readout. The reason for this is not apparent to me. However, by moving the cursor one position and back again the number will be printed. To change the termination change the ASCII number at OE09 Hex.

*Yours faithfully,
A Gavriluk
Morecambe*

Dear Sir,

Just to put the record straight. In April's issue The Valley article carried a claim that the method used for determining a move direction was first — "no one appears to have thought of it before".

I have seen something similar at least twice before and both were in CT! (A Softspot in May 1979 and a modified version of Etch a Sketch on page 46 of the October issue of that year to be precise.) True, these articles only use a four-way direction routine but it is a simple matter to expand it to an eight-way routine.

I have been using an eight-way software joystick (as I call it) for years, based on the routines above.

*Yours faithfully,
T H Van Rieenen
Pretoria*

(* Well, it only goes to prove that nothing is ever really new! Thanks for pointing this out — our mathematical colleague who devised the routine had the grace to blush! Ed. *)

Dear Sir,

As I am a newcomer to information technology, I have searched for a suitable microcomputer which

would both meet my needs and not cost the earth. At last I have found the ideal computer—the ZX Spectrum — but I require information on the following things:

(1) Can I/O Ports and memory expansions designed for the ZX 81 be compatible with the ZX Spectrum. If not for what reasons?

(2) Can programs and tapes written for the ZX 81 be used on the ZX Spectrum. If not what are the differences?

(3) Has any company produced a Spectrum compatible I/O Port for sale to the public?

(4) Lastly, after wearing my fingers flat typing out the line numbers on the BBC Model A computer wouldn't it be a great idea if you could publish an auto line number program for the BBC Model A and the ZX Spectrum. I would be most grateful if you could obtain such a program because it would be most helpful to the many BBC Model A owners and the growing number of ZX Spectrum users who read your magazine.

I also would be most grateful if you could publish this letter as it would alert BBC and Spectrum users that someone has inquired about these problems, and that hopefully these problems will be solved soon.

*Yours faithfully,
Michael Wlach
Manchester*

(* The answers are as follows:

1) No. As we reported in our review last month the output port is almost completely different and the only compatible device is the ZX Printer.

2) Programs can be modified to run quite simply but tapes will not load as the cassette interface uses a different format and is much faster on the new machine.

3) Not yet, as far as I know, but they are bound to come soon.

4) I thought the BBC had an auto line number command! It will doubtless not be long before a program appears for the Spectrum, it is quite simple to produce. Ed. *)

Dear Sir,

I live in Cambridge and am a very lonely MZ-80K user. I have a lot of software, but not much money, so I write my own programs (and sell some of them commercially).

However, I only know of one other MZ-80K owner and he lives some distance from me.

I wonder if there are any other MZ-80K owners in Cambridge who would be interested in starting up a users group. If there are any other owners in the area please contact me at the address below.

Yours faithfully,
Piers Hendrie
19 Madingley Road
Cambridge
CB3 0EG

Dear Sir,

Reading the CT Standards section in July Computing Today, I was interested by your comments about jumps which go to REM statements.

I try and use this technique wherever possible because it not only makes the REM a kind of paragraph heading for the code that follows, but also makes it far easier to delete or add lines in front of the 'jumped to' code. As a programmer by trade, I use something very similar in the programs I write at work and it helps to reduce the number of lines that might have to be changed.

Although REM's undoubtedly occupy valuable space I think it would be wrong for you to specify standards which are based solely on the limitations of current micro storage hardware. Storage space is getting continually cheaper, as Sinclair's Microdrive is about to demonstrate, but time wasted in trying to analyse a program without comments is time (and money) that is lost forever.

Yours faithfully,
Mike Dean
Finchley

(* Whilst I can agree with you on the point you make regarding the preservation of REMs as aids to understanding the program I feel that you may have slightly missed my point. What I am endeavouring to establish is that published programs don't jump to REMs because when users type in the program at home they may ignore the REMs or, even worse, compact the program. This results in an originally working program suddenly throwing out all sorts of weird errors that the novice may not then be able to deal with. By all means use REMs as jumps in your programs but if you are sending them in for publication

please try to follow our guidelines. It must be said that it's nice to find someone who actually understands the value of a REM, many programmers regard them as wasted space and this is not something I wished to imply Ed. *)

Dear Sir,

We are a Cheshire home for the physically handicapped, and have recently bought an Apple II microcomputer, now being adapted for use by severely handicapped operator, initially as an aid to solving some very basic problems and for recreation, viz:-

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The idea is to provide a link between all organisations and individuals who are working in the field of computing for the physically handicapped. We would welcome enquiries from Schools, Colleges and Residential Homes etc.

If interested please write, enclosing SAE, to the address below.

Robin Nixon
Seven Springs Cheshire Home
Pembury Road
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Dear Sir,

Program Protection

The suggestion on page 53 of the June issue could be greatly improved if the SYS call was made to disappear from the program listing.

Otherwise all one has to do, having met with difficulties on running the purloined program, would be to list and search for odd looking SYS calls and see what happens by removing them via the editor.

The SYS1000 call should be introduced at the end of an early statement and made to 'vanish' by the use of 'deletes' in quotes as follows:

```
150 DIM A(50):SYS 1000"
      dddddddddd
```

where 'd' is a delete character.

This is achieved by inserting 'delete' characters into quotes and then deleting the final closing quote. (It certainly works on the Commodore PET; as for other machines another method should be possible.)

Yours faithfully,
D A A Fagandini
Dulwich

Dear Sir,

As a dealer I can understand fully Mr Tidman's problems of interfacing his printer to computer. He commented, after he had decided on the Epson MX-80F/T that, "the next stage was to phone around looking for a deal". What he did not include in his looking was for a supplier who would set up and test the printer for his machine. This, of course, costs money but how much is a day of his time worth? And, as he said, it is a competitive field.

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Yours faithfully,
Bob Robinson
Managing Director
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324 Euston Road
London NW1 3BG

Dear Sir,

I have just received my copy of The Valley after about a weeks wait, which is a pity, because I had intended it to arrive just after my finals (Elec Eng) to fill in time before the dreaded results. As a result of the games addictive qualities, I feel that my chances have, to say the least, not been improved.

I, hope, therefore, that if the worst comes to the worst, you will do the decent thing and offer me a job.

Yours sincerely,
Peter Henry (B.Eng?)
Merseyside

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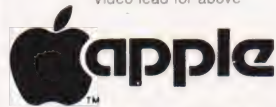
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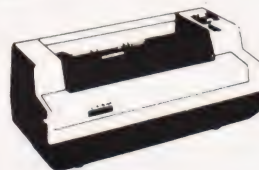
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Our regular page explaining the meaning of the various symbols we use to make programs portable.

It has been very encouraging to see the number of programs submitted using our standard codes for graphics and other non-printable characters. However, it has also become increasingly clear that some of our readers haven't heard of them and this page is intended to set them out once again.

All standards tend to be irksome to adhere to but the ones laid out here are fairly simple and tend to make software easier to maintain by the programmer and simpler to understand for others.

Controlling That Cursor

Our original standards have now grown with the times. Machines such as the Commodore VIC which have a dual Shift capability can now be incorporated, as can those systems which use Control key functions.

The recently introduced BBC system offers pre-programmed function keys which, we are glad to say, can also be handled by our original coding system. It's nice to see just how well adapted the original standards have become over the last two years! (Indeed, a whole series of books is using them as its *de-facto* standard.) The standards for the cursor controls are given in Fig. 1.

[CLS]	CLeAr Screen
[HOM]	HOmE cursor
[CL]	Cursor Left
[CR]	Cursor Right
[CU]	Cursor Up
[CD]	Cursor Down
[REV]	REverse video on
[OFF]	Turn it OFF
[SPC]	SPaCe
[CTL]	ConTRoL key
[fn]	Function key (BBC)
[G<]	Graphic left (VIC/MZ-80A)
[G>]	Graphic right (VIC/MZ-80A)

Fig. 1. Our extended set of cursor control standards includes four new functions.

To indicate more than one of the above, an optional number can be placed within the brackets; [4CL], etc.

The use of square brackets has raised one or two queries. The reason for this choice is that *most* of the common microcomputer BASICs don't use them for specific functions. In fact, at least one machine provides an added bonus by returning a Syntax Error if they are found, a useful check in case you type them in by mistake.

The code [SPC] was added to the list of cursor control codes to get over the problem of indicating just how many spaces are contained in the gap in the printout. The other common variant of the code for spaces is used by the ZX people. Their choice was $\underline{\quad}$ and this crops up in the various newsletters they publish.

The code [RVS] has caused a few headaches. This is really specific to the PET where the character set can be displayed in reversed video. On machines which don't have this facility you should either find a character in the set which is the reversed image of the one you want and use that or simply ignore it and use anything else you fancy!

Don't forget, you may have to look up and alter the values used elsewhere in the program.

The Graphic Solution

It soon became obvious that the techniques applied to the confusing cursor controls could also be applied to the graphics symbols. The following standard is now in general use in programs published in Computing Today.

If a graphics character or characters are to be displayed in a listing (as opposed to POKE codes or CHR\$() codes) then they are indicated by the method shown in Fig. 2.

Several people have asked what the relationship between the POKE value for a character and that of its shifted graphic might be. In general the shifted version of any character will be 64 greater than the value of that character. This applies to both PET and MZ-80K systems in all cases.

This can be taken further to include machines which use a pixel graphics set rather than pre-programmed PET-style characters and the series of codes for these is given in Fig. 3. As is nearly always the case there is one machine to which the standard

Making REMarks

Many people scorn the use of REMs within programs but, during the development at least, they are extremely useful. One of the documentation methods that we use is to keep our back-up copy of our programs on a 300 Baud CUTS tape with all the REMs in place: the working copy, be it on tape or disc, is REMless in order to save space.

It is also good programming 'manners' to give your REMs odd line numbers:

```
3999 REM ** CRASH PROOF INPUT
```

```
4000 INPUT "THE NUMBER OF ENTRIES ":AS
```

A remarkable number of submitted programs have jumps that go not to the relevant point in the program, but to the REM statement. This can cause severe problems when re-numbering after removing the REMs.

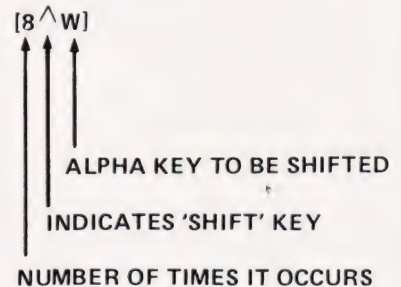


Fig. 2. The way we indicate block graphics on machines like the PET and Sharp. The VIC system of Shift Left and Shift Right is shown in Fig. 1.

1	2
4	8
16	32
64	128

Fig. 4. To convert a Tangerine pixel code into its blocks, simply decode the number into its binary or Hex value and fill in the relevant squares.

shown in Fig. 3 does not apply — Tangerine's Microtan/Micron. This machine uses a four by two cell structure for its pixel graphics instead of the Prestel/Teletext three by two cell. The method for calculating the value to assign to 'P' is shown in Fig. 4, and is fortunately nice and simple.

□□	■□	□■	■■	□□	■□	□□	■□	□□	■□	□□	■□	□□	■□	□□	■□
□□	■□	□□	■□	□□	■□	□□	■□	□□	■□	□□	■□	□□	■□	□□	■□
□□	■□	□□	■□	□□	■□	□□	■□	□□	■□	□□	■□	□□	■□	□□	■□
[P0]	[P1]	[P2]	[P3]	[P4]	[P5]	[P6]	[P7]	[P8]	[P9]	[P10]	[P11]	[P12]	[P13]	[P14]	[P15]
□□	■□	□□	■□	□□	■□	□□	■□	□□	■□	□□	■□	□□	■□	□□	■□
□□	■□	□□	■□	□□	■□	□□	■□	□□	■□	□□	■□	□□	■□	□□	■□
□□	■□	□□	■□	□□	■□	□□	■□	□□	■□	□□	■□	□□	■□	□□	■□
[P16]	[P17]	[P18]	[P19]	[P20]	[P21]	[P22]	[P23]	[P24]	[P25]	[P26]	[P27]	[P28]	[P29]	[P30]	[P31]
□□	■□	□□	■□	□□	■□	□□	■□	□□	■□	□□	■□	□□	■□	□□	■□
□□	■□	□□	■□	□□	■□	□□	■□	□□	■□	□□	■□	□□	■□	□□	■□
□□	■□	□□	■□	□□	■□	□□	■□	□□	■□	□□	■□	□□	■□	□□	■□
[P32]	[P33]	[P34]	[P35]	[P36]	[P37]	[P38]	[P39]	[P40]	[P41]	[P42]	[P43]	[P44]	[P45]	[P46]	[P47]
□□	■□	□□	■□	□□	■□	□□	■□	□□	■□	□□	■□	□□	■□	□□	■□
□□	■□	□□	■□	□□	■□	□□	■□	□□	■□	□□	■□	□□	■□	□□	■□
□□	■□	□□	■□	□□	■□	□□	■□	□□	■□	□□	■□	□□	■□	□□	■□
[P48]	[P49]	[P50]	[P51]	[P52]	[P53]	[P54]	[P55]	[P56]	[P57]	[P58]	[P59]	[P60]	[P61]	[P62]	[P63]

Fig. 3. The standard pixel codes; they will work on most computers which employ this technique as well as for Teletext and Prestel.

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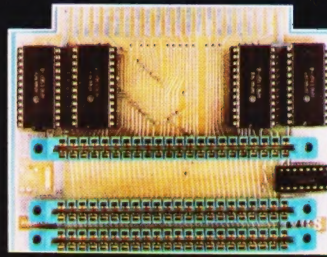


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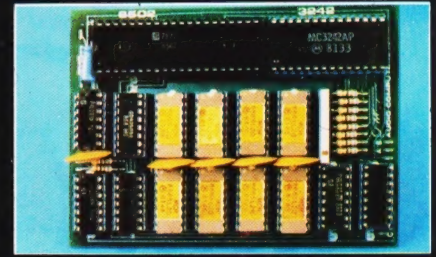
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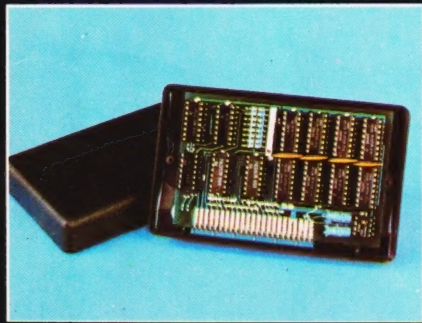
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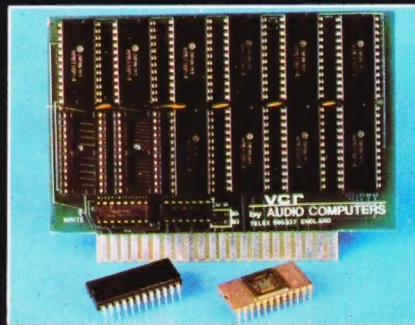
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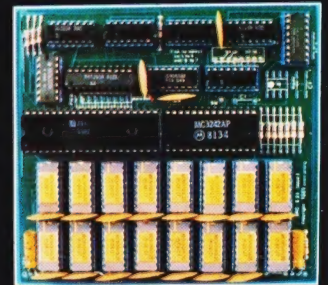


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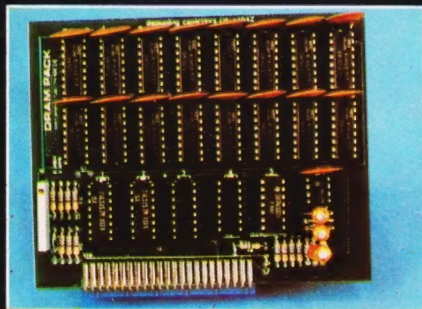


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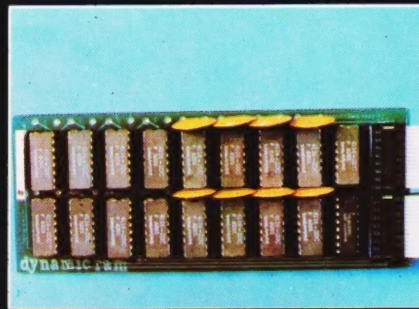
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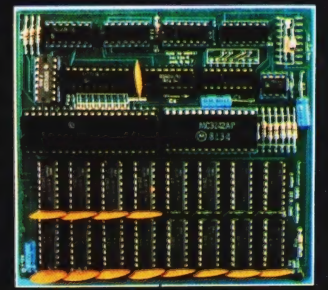
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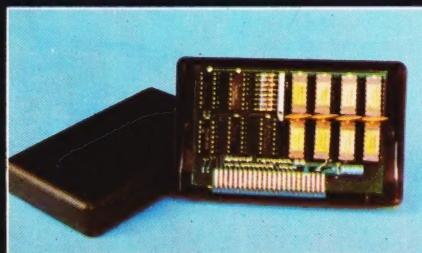
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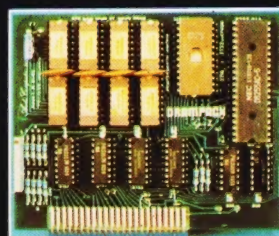
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